October 1954

MECHANICAL ENGINEERING

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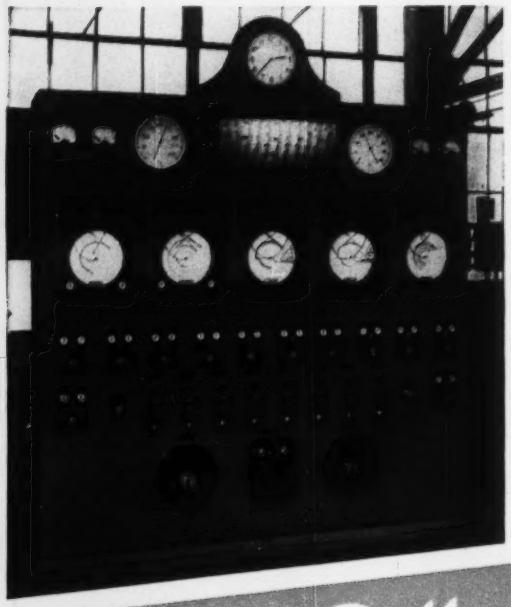
ASME Annual Meeting, New York, N. Y.
Nov. 28–Dec. 3, 1954



This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service — conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-1

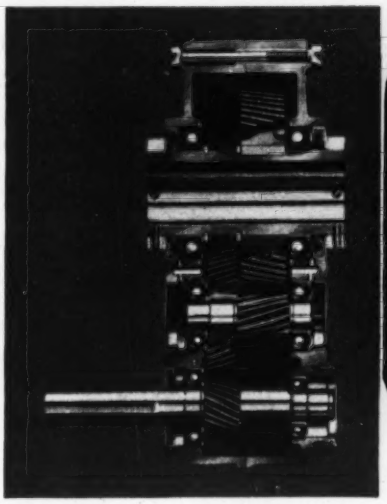
BAILEY METERS

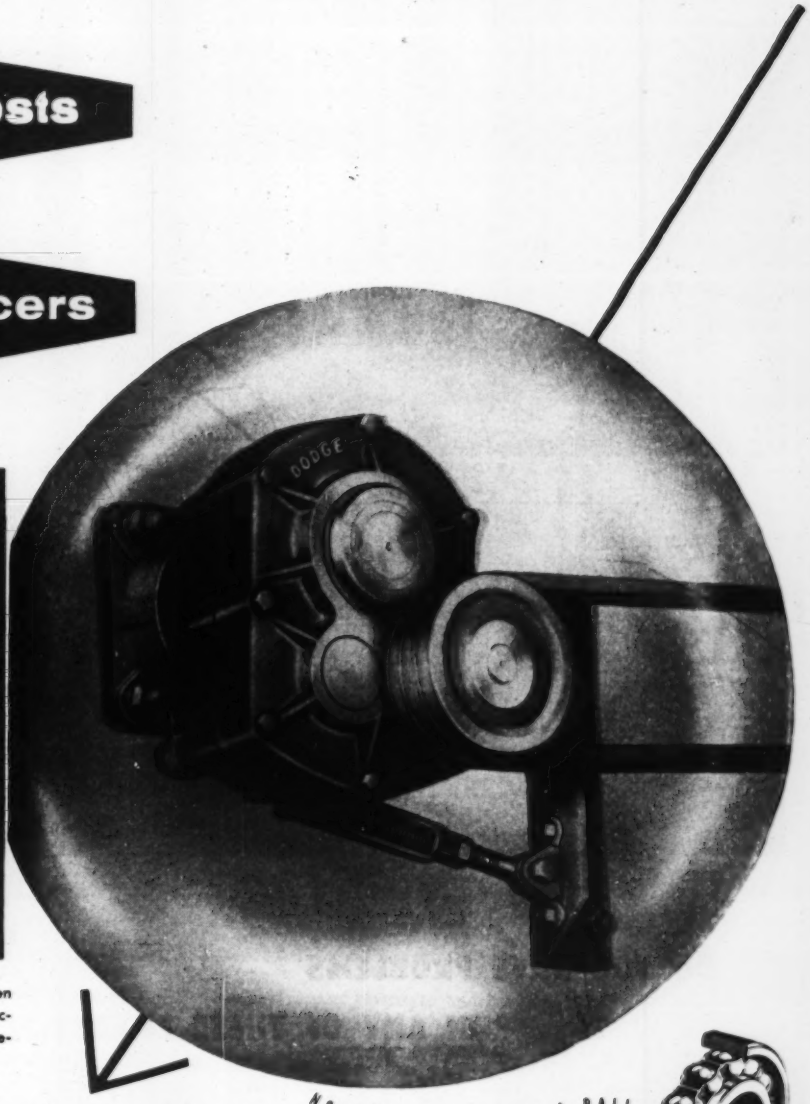
BAILEY METER COMPANY

1026 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

Reducing Costs in Speed Reducers





New Departure **ball** bearings are used in seven basic sizes of the Dodge single and double reduction speed reducers, handling from 1 to 43 horsepower at output speeds from 12 to 330 r.p.m.

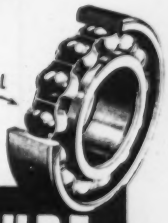
. . . with NEW DEPARTURES

Dodge Manufacturing Corporation's Speed Reducers make good use of design advantages offered by New Departure snap-ring **ball** bearings.

The snap rings locate the bearings in the case, eliminating the need for adjustment. Doing away with threaded or shim-type devices permits straight-through boring of the housing. Thus split-case construction is highly practical, and assembly is greatly simplified. The result is a rigid, highly efficient unit, and one in which production costs have been kept to the minimum.

Learn what New Departure can do for *your* product. Talk with your New Departure sales engineer—*today!*

NOTHING ROLLS LIKE A BALL



NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Plants Also in Meriden, Connecticut and Sandusky, Ohio
In Canada: McKinnon Industries, Ltd., St. Catharines, Ontario

NEW DEPARTURE SALES ENGINEERING OFFICES—AT YOUR SERVICE

BRISTOL	269 North Main St.	2-6371	**DETROIT**	7-122 General Motors Bldg.	Trinity 2-4700	**KANSAS CITY**	1021 E. Linwood Blvd.	Valentine 4939
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KANNAPOLIS, N. C.	P. O. Box 1086	2-3181	**CLEVELAND**	3113 W. 110th St.	Winston 1-5454	**ST. LOUIS**	3001 Washington Blvd.	Franklin 6533
NEW YORK	1775 Broadway	Circle 6-1540	**INDIANAPOLIS**	1357 W. 18th St.	Imperial 4680	**LOS ANGELES**	5035 Gifford Ave.	Logan 8-2301
PHILADELPHIA	850 E. Luzerne St.	Garfield 3-4136	**PITTSBURGH**	Cathedral Mansions	Mayflower 1-8100	**BERKELEY**	1716 Fourth St.	Landscape 6-8750
SYRACUSE	2360 James St.	73-5195	**CHICAGO**	332 So. Mich. Ave.	Wabash 2-5875	**SEATTLE**	5000 First Ave., S.	Lander 5920
			DAVENPORT	2212 E. 12th St.	Davenport 7-7522			

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DO YOU HAVE PROBLEMS IN ANY OF THESE FIELDS?

- ☐ STRESS ANALYSIS
- ☐ ADVANCED THERMODYNAMICS
- ☐ HEAT TRANSFER
- ☐ APPLIED MATHEMATICS
- ☐ REFRIGERATION TO −456°F
- ☐ DYNAMICS
- ☐ AUTOMATIC CONTROLS
- ☐ VIBRATION
- ☐ ELECTRICITY
- ☐ MAGNETISM
- ☐ MECHANICAL DEVELOPMENT
- ☐ MACHINE DESIGN
- ☐ NOISE REDUCTION

These are fields in which our Mechanical Division can help you solve your problems . . . without adding complex facilities and highly trained personnel to your staff, for which you have only temporary use.

In our Mechanical Division is concentrated a greater diversity of specialized personnel and facilities than most companies can normally focus on a research or development problem. Here scientists blend their knowledge and talent with the industrial experience of engineers and other technologists. This team is ready to work with your organization on one or more of the following bases:

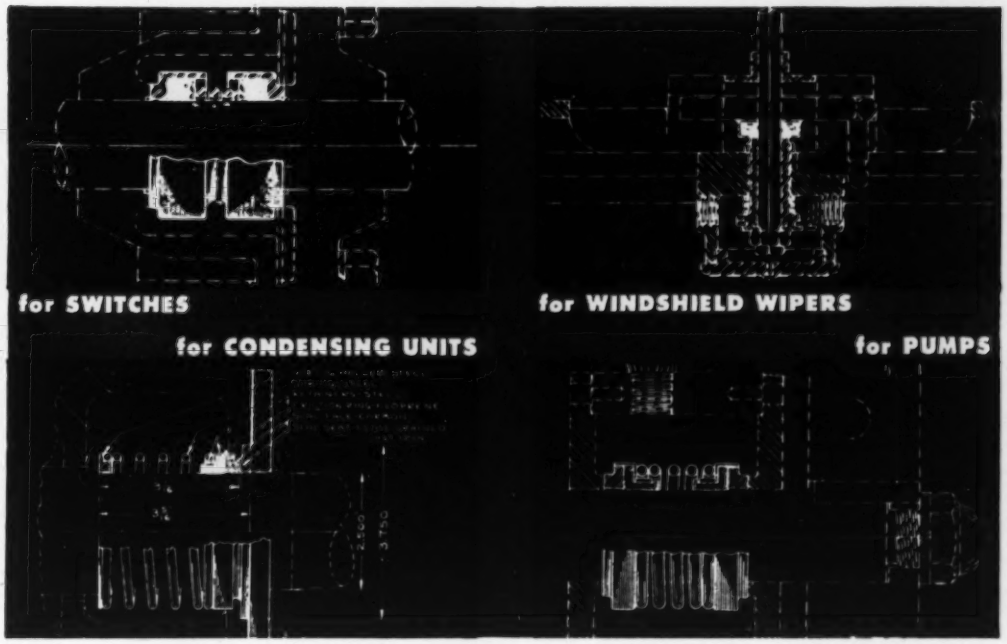
Basic research
Complete development after basic research
Refinement of existing equipment
Prototype construction
Construction of complete process equipment

Whether your problems are small or large, usual or unusual, new or old, outside help by our Mechanical Division can be a valuable asset to you.
WRITE TODAY for Bulletin No. XX-1.

MECHANICAL DIVISION
Arthur D. Little, Inc.
37 Memorial Drive, Cambridge 42, Mass.

Stuck for the Right answer to a Shaft-Sealing problem?

TURN TO... **ROTARY SEALS**



When ordinary methods won't do the job—yet *Shaft-Sealing Certainty* is a *must*—the proper ROTARY SEAL is usually the answer. ROTARY SEALS stop Shaft-Sealing troubles before they start, because they're *tailor-made* for each specific application.

The basic sealing principle originally introduced by ROTARY SEAL more than 20 years ago has naturally been imitated up to a point. But the broad experience of ROTARY SEAL engineers is inimitable. That experience makes it possible to adapt the basic ROTARY SEAL principle in just the right way—with the correct facings, springs and other details—to give you complete assurance of positive, trouble-free Seal performance under *your* conditions.

The illustrations above suggest only a few of the many successful uses of ROTARY SEALS. You'll find them "standard equipment" among leading makers of PUMPS—HYDRAULIC DEVICES—COMPRESSORS — APPLIANCES — GEAR BOXES—HEAVY DUTY WINDSHIELD WIPERS—AGRICULTURAL MACHINERY—and in scores of other applications where *Shaft-Sealing Certainty* is vital even under the most rigorous conditions.

The best time to start solving *your* Shaft-Sealing problem is at the drawing-board stage. Call in our engineers for an early consultation—and send for your copy of our brochure, *"Sealing with Certainty"*, which explains and illustrates the ROTARY SEAL principle.

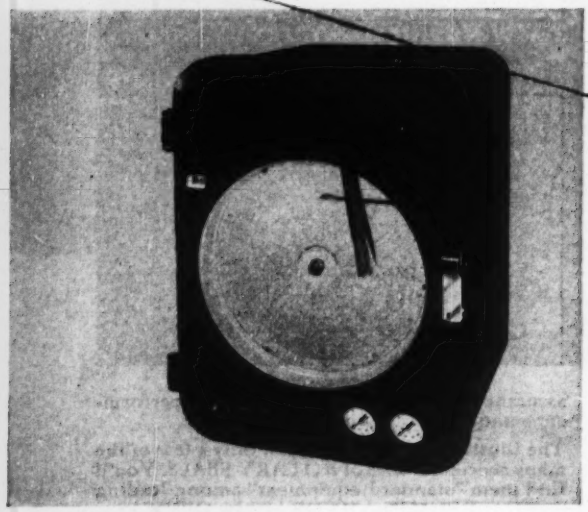
THE ROTARY SEAL COMPANY — mechanical seals for rotating shafts

Shaft-Sealing with Certainty

2024 NORTH LARRABEE STREET
CHICAGO 14, ILLINOIS, U. S. A.

HAGAN

Ring Balance Meter *beats the high cost of* Permanent Pressure Loss!



It works out like this:

Using an Expensive Primary Element . . . 10% of 100″ full scale differential is *10″ PPL*

Using a Low Cost Primary Element . . . 50% of 6″ full scale differential is *only 3″ PPL*

The Hagan Ring Balance Meter is particularly adapted for accurate operation at full scale differentials as low as 1″ WC, with *any* type of primary element. In many applications, by choosing a low cost, low differential element, with a PPL of 50% or more, and measuring the flow with a Ring Balance Meter, the actual permanent pressure loss is low. In the example shown above, *it is only a third of the actual PPL* sustained with a high cost, high differential primary element. Here is positive, long range economy . . . lower pumping costs result from reduced horsepower requirement.

This is an example of how Hagan experience and engineering skill can reduce costs. Hagan engineers will be glad to recommend the most economical solution to your metering problem.

HAGAN HALL BUROMIN CALGON

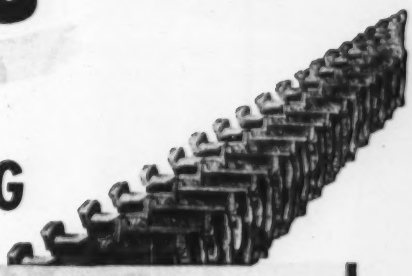
HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

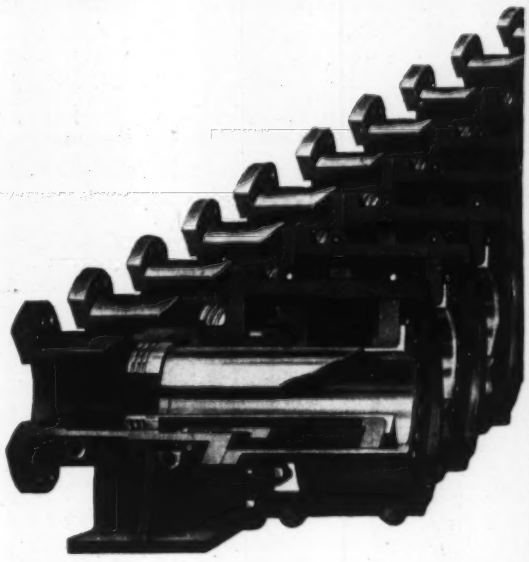
Boiler Combustion Control Systems, Ring Balance Flow and Pressure Instruments . . . Metallurgical Furnace Control Systems . . . Control Systems for Automotive and Aeronautical Testing Facilities

6500 JOINTS

CAN'T BE WRONG



● You're sure to find the right one at **ADSCO**



No matter what expansion joint you need, look first among ADSCO's 6500 standard slip models. Manufacturing the world's most complete line of expansion joints, ADSCO is able to make a thorough analysis of your pipe expansion problems and to offer an impartial recommendation on the type of joint to use. Even if your problem is a unique one, remember that ADSCO has specialized since 1877 and can readily engineer a special joint to fit your needs.

King of ADSCO slip joints is the Piston-Ring, shown here. This exceptionally well-engineered and well-built joint carries the mark of ADSCO quality. Piston-ring feature permits it to be unpacked and repacked while maintaining full line pressure; thus service is not interrupted. Limit stops prevent over-travel of slip. Polished surface of slip cannot be scored because it is in contact with packing only. True alignment is assured by both internal and external guiding; split external guide permits smaller manholes. Full range of sizes, with 4", 8" and 12" traverse per slip, for pressures to 400 psi and greater and for temperatures to 800F and higher. Call an ADSCO representative or write for Bulletin 35-15H.

Use ADSCO Alignment Guides With ADSCO Expansion Joints

Don't let pipes get out of line. Use ADSCO Alignment Guides. Cylinder is 12" long in all sizes, permitting pipe movement of 10". Damage to insulation prevented by ample clearance between guiding cylinder and pipe.

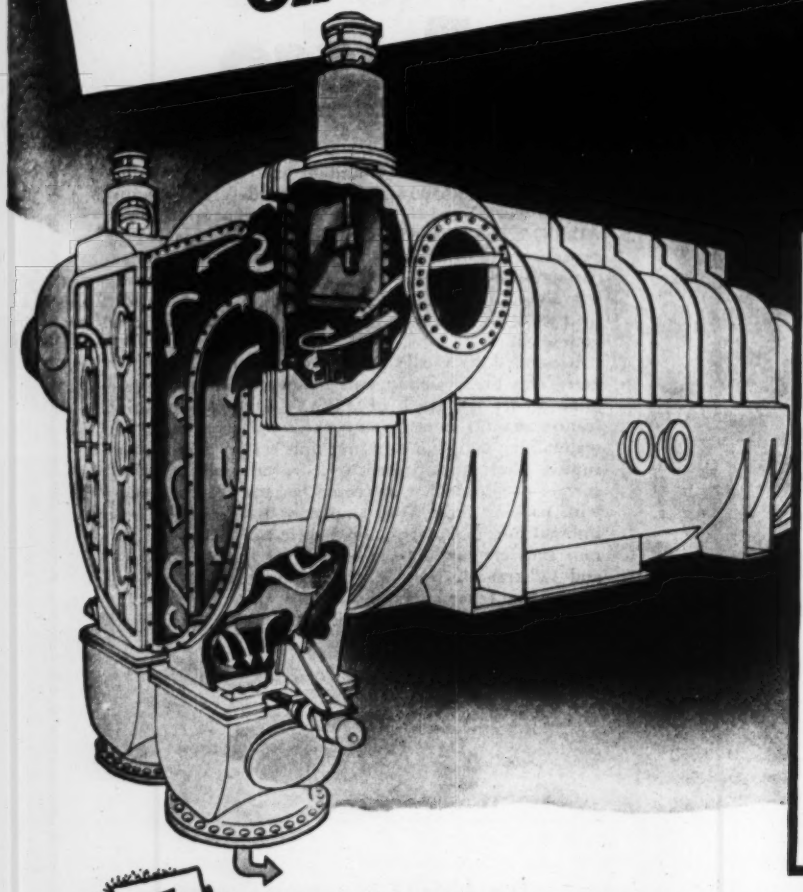
ADSCO ENGINEERED PRODUCTS

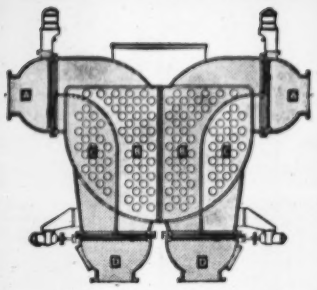
EXPANSION JOINTS
HEAT EXCHANGERS
STEAM TRAPS
STRAINERS
SEPARATORS
METERS

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS: NORTH TONAWANDA, N. Y. – RICHMOND, CALIF.

Here's a 3-WAY "ASSIST" On Your Power Plant Problems





HERE IS HOW REVERSE FLOW WORKS

Reverse flow sluice gates on divided water box condensers work the same in both halves but independently of each other. Right side: normal flow. Water enters divided water box in valve chamber "A" with lower port open. It flows through pass "C" to end of condenser, back through pass "B" and out through left port of "D."

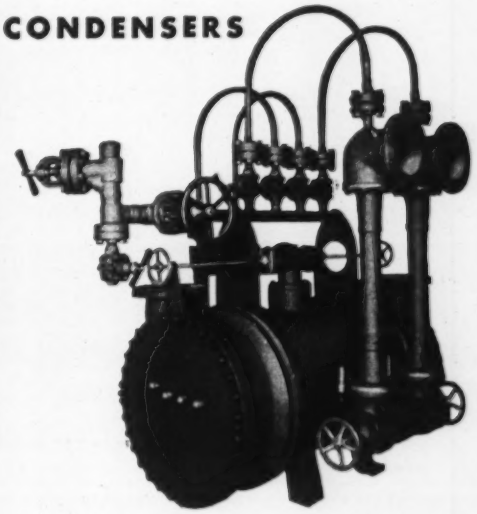
Left side: flow is reversed. Valves at inlet "A" and discharge "D" are changed to permit water to flow through "B" and back through "C" in the opposite direction and then out through the left port of "D."

1 CLEAN DEBRIS FROM CONDENSER TUBE SHEETS WITHOUT DOWNTIME OR LOSS OF VACUUM

C. H. Wheeler "Reverse Flow" Condenser design provides a powerful self-cleaning flushing force by the simple procedure of reversing the flow of water through the tubes. Electrically or hydraulically controlled sluice gates accomplish in minutes cleaning that consumes hours of downtime when removal of debris is done by hand. Power plant modernization calls for the efficiency and uninterrupted operation of C. H. Wheeler "Reverse Flow" Condensers. You don't need costly water straining apparatus. Send for latest bulletin #410.

2 VACUUM PUMPS WITH LOWEST MAINTENANCE FOR YOUR STEAM CONDENSERS

C. H. Wheeler Steam Jet Ejectors are the development of 35 years of pioneering in this field. Known as "Tubejets," these vacuum pumps have no moving parts. Hence, they are simple to operate, require almost no maintenance and last longer. Modern Power plants use single or two-stage Tubejets with surface inter-after condenser for the vacuum requirements of steam condensers. Special arrangements of standard Wheeler ejector assemblies can be provided for any unusual installation or performance requirements. Catalog #1462 gives you detailed descriptions and some useful temperature and pressure conversion tables. Write for it.



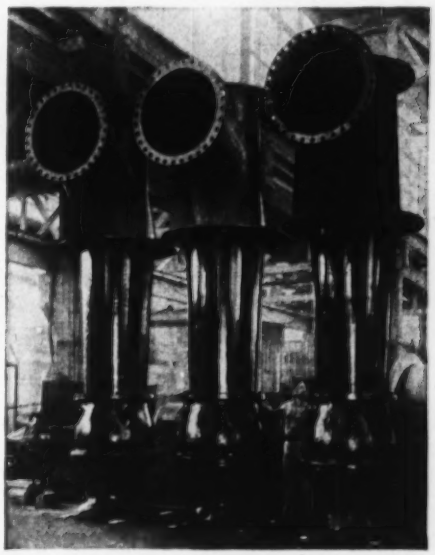
SPECIAL TYPE TUBEJET VACUUM PUMP FOR HIGH PRESSURE AND HIGH SUPERHEAT

3 WHEELER-ECONOMY CIRCULATORS HANDLE LARGER VOLUMES OF WATER AT LOWER COST

Wheeler-Economy Pumps for Condenser Cooling Water Circulation are made in horizontal double suction and vertical submerged, axial mixed flow types. These pumps are noted for reliability, the result of superior modern design and heavy duty, quality construction. They are built in all sizes to meet capacity requirements up to 200,000 GPM. Wheeler-Economy Circulating Pumps are also furnished in special metals to handle corrosive waters. The impellers are designed for satisfactory operation during all load requirements.

Economy engineers are pioneers in the successful application of axial flow pumps in circulator service. These pumps can be furnished in "pull-out" type with distinctive design features, permitting removal of all operating parts, without dismantling the complete pump or disturbing any pipe connections.

For top performance in power plant duty count on Wheeler-Economy Pumps. Write for catalogs #G-349 and G-1050.



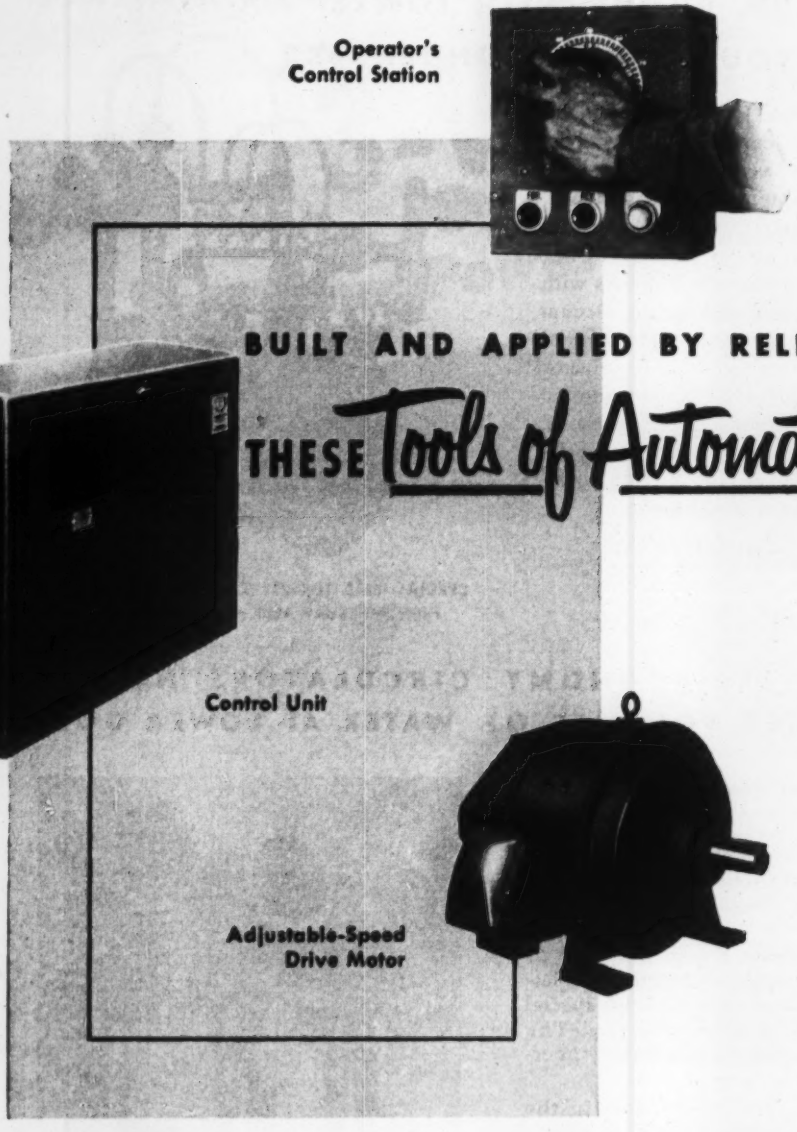
THREE CIRCULATORS OF 28,000 G.P.M. CAPACITY, 35 FT. TDH, 575 RPM.

105-R

C. H. WHEELER of Philadelphia

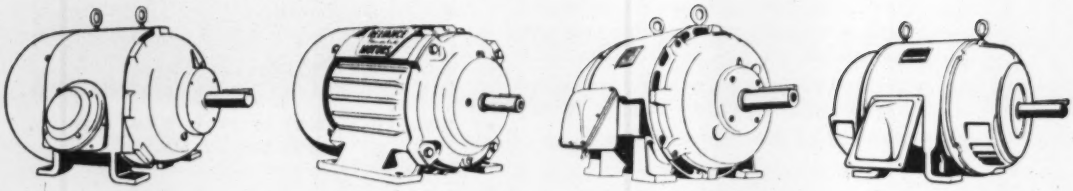
C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Vacuum Refrigeration • High Vacuum Process Equipment • Micro Particle Reduction Mills • Marine Condensers and Ejectors • Deck Machinery



BUILT AND APPLIED BY RELIANCE

THESE *Tools of Automation* BOOST



RELIANCE ELECTRIC AND ENGINEERING CO.

1062 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities*

RELIANCE V★S DRIVE

Precision-Built

PRODUCTION EFFICIENCY IN EVERY INDUSTRY

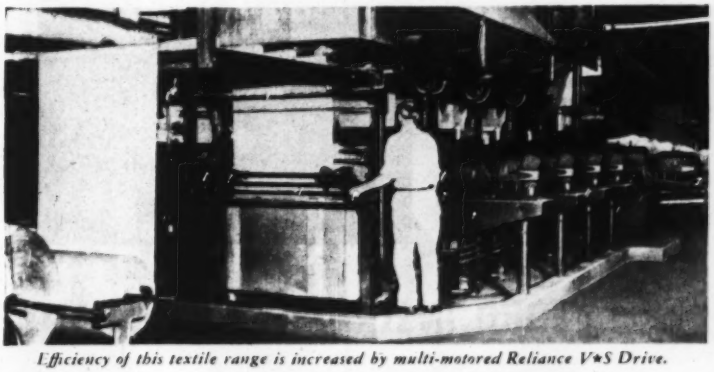
. . . Moving Everything from Textiles to Engine Blocks

at less cost

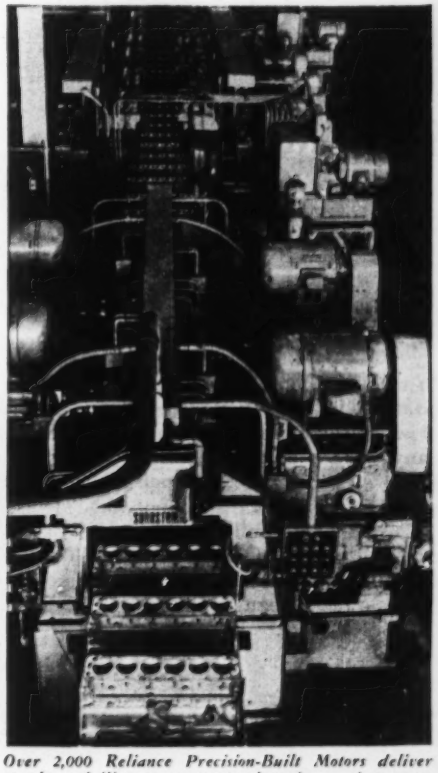
If you're looking around for ways to improve your profit ratio—then take a look at these Tools of Automation! They include Reliance motors, adjustable-speed drives, electronic controls, and applied engineering. They've made a lot of companies a lot more competitive.

They are used in the world's largest and most completely automated engine plant. And you will find them delivering outstanding performance on machinery in paper, steel, machine tool, textile—in fact, in every industry.

The nearly 50 years of practical, first-hand experience Reliance has in developing, building and applying the Tools of Automation are available to help you automate a single machine . . . a process . . . or a complete production line. For all the facts, write for our new booklet, "The Tools of Automation". A-1485

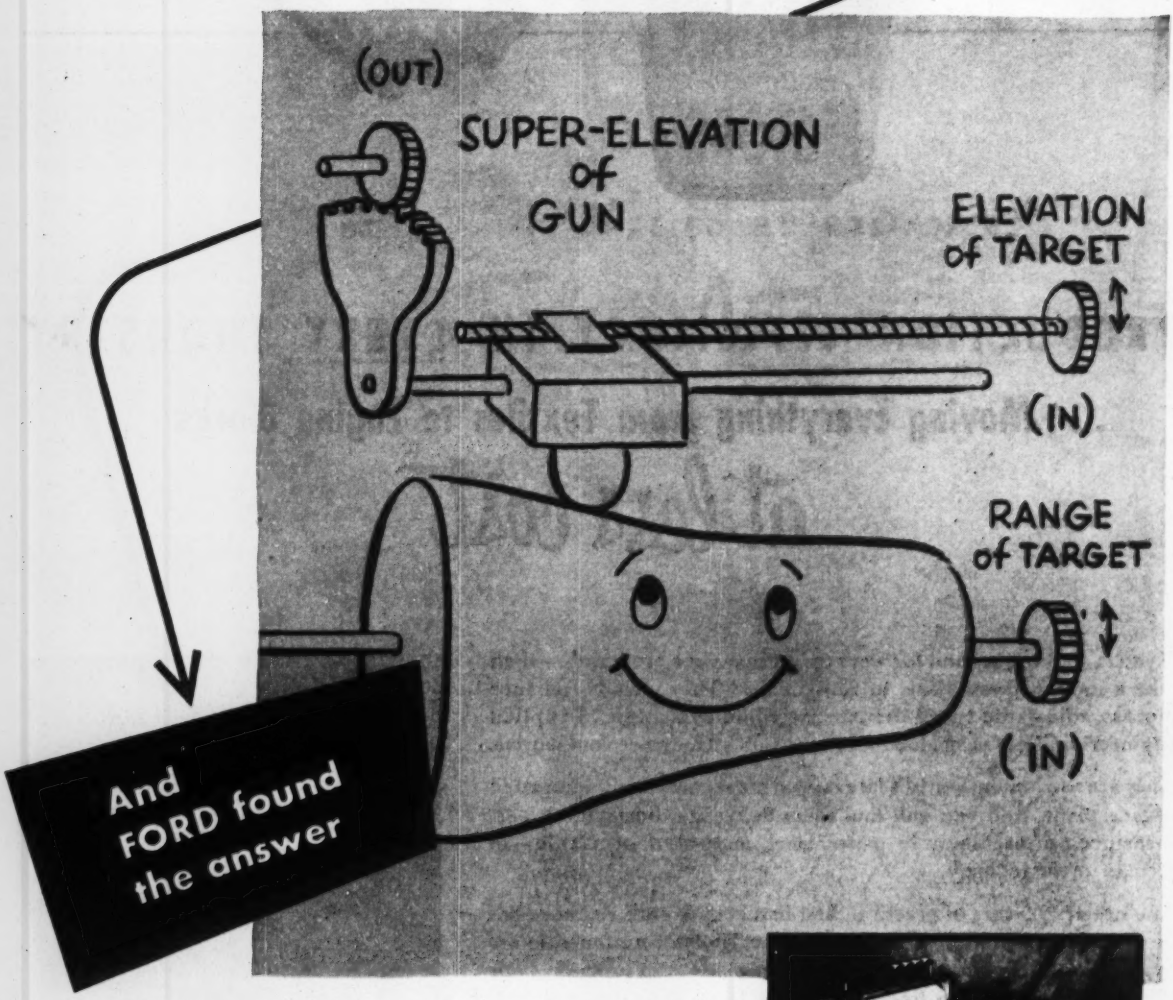


Efficiency of this textile range is increased by multi-motored Reliance V★S Drive.



Over 2,000 Reliance Precision-Built Motors deliver steady, unfailing power to speed engine castings automatically through 26 machine operations.

HOW TO TAP THE BRAIN
of a piece of metal



In making computers, such information as mathematical functions can be stored in a precision-cut cam, thus allowing its follower to be displaced in accurate reply to the input position of the cam. Ford Instrument Company designs and makes cams of all sizes and shapes to achieve these results. To manufacture such cams with the precision demanded, the engineers of Ford Instrument have devised remarkable automatic machines which, by following a carefully plotted ink line on a roll of paper, cut the exact shape into the metal. Then, careful point-by-point checks, sometimes as many as 2000 measurements, insure finest accuracy.

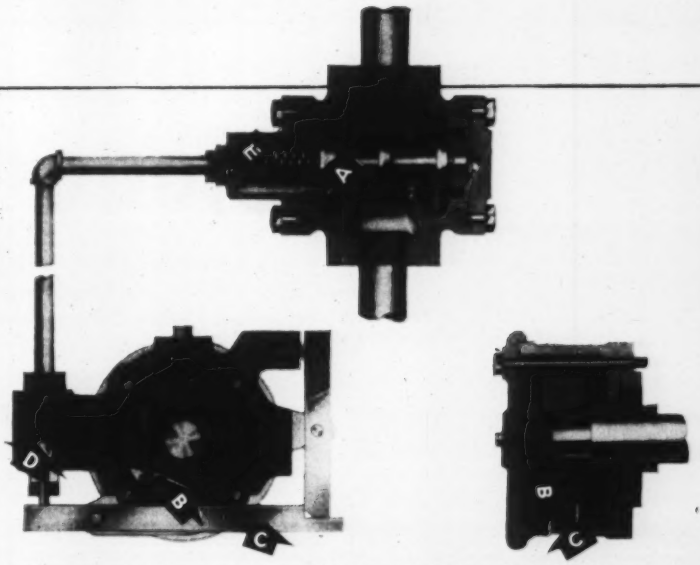
If you have a cam problem—call on Ford Instrument Company.

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

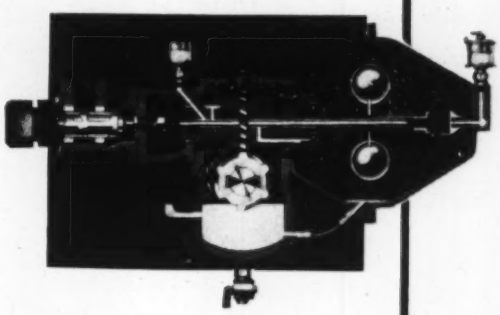
28

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When turbine is operating, Lever C is horizontal, Pilot Valve D closed, and Valve A held open by Spring E. When excess speed is reached, centrifugal force throws Weight B against Lever C, opening Pilot Valve D. This relieves the pressure back of Valve A, unbalancing and closing it immediately, compressing Spring E and shutting off the steam supply to the turbine. When Lever C is manually reset, Pilot Valve D closes, allowing pressure to build up back of Valve A and thus restoring the balance. Spring E then opens Valve A, admitting steam to turbine.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION 370 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

275,000 kw
The turbine-generator will be a single-shaft unit rated at 275,000 kw—the largest ever ordered. Throttle pressure—5000 psi. Steam temperature—1200 F. (Initial operation at 1150 F.)
FOR THE 1ST TIME
ANYWHERE
at the new power station to be built by
PHILADELPHIA ELECTRIC COMPANY

6000 psi
1200 F

The boiler, to be built by Combustion, will be a C-E Sulzer Monotube Steam Generator of the "once-through" type, designed for a pressure of 6000 psi. Steam temperature — 1200 F.

8400 Btu/kwhr

Expected heat rate for the new station at 5000 psi throttle pressure and steam temperature of 1150 F is 8400 Btu per kwhr.

Combustion Engineering, whose equipment has been identified with many history-making power stations of the past, is especially proud of its selection to design and build the boiler for the new station of Philadelphia Electric Company — a station that represents the most advanced power practice to date.

COMBUSTION ENGINEERING

Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

8-754

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS AND FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

IRVING GRATINGS UNEXCELLED From Every Angle!

Engineering-Wise:

1. Irving *specializes* in the manufacture of *all types* of gratings. Irving engineers are prepared to handle any grating problem, no matter how complicated (such as proper fit, unusual conditions of stress, corrosion, etc.).
2. Complete pre-order service by Irving estimating staff includes prompt, accurate recommendations and quotations. All orders are checked by engineers with years of specialized experience.
3. Comprehensive drafting organization assures precision manufacture plus uninterrupted flow of production; accurate erection drawings supplied with every order.
4. Prior to shipment gratings are carefully inspected for conformity to specifications and to Irving high standards of quality.

Economy-Wise:

- Precisely fabricated panels make installation easier, faster.
- Costly mistakes are avoided by utilizing up-to-date engineering skill and valuable experience unique with Irving.
- Irving quality gratings require minimum maintenance.
- Irving reputation of over 50 years of customer satisfaction is your guarantee of effective grating application.

Performance-Wise:

Non-skid; fireproof

Strong; self-draining

Self-ventilating; durable

Irving ALUMINUM Gratings– rustproof, sparkproof, lightweight

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ESTABLISHED 1902

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Plants:
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Write today for our illustrated catalog containing engineering data on Irving Riveted, Welded and Press-locked gratings that will save you time and money!

For *positive* bearing protection on Military Jeeps-

KLOZURE Garter Spring Model 65

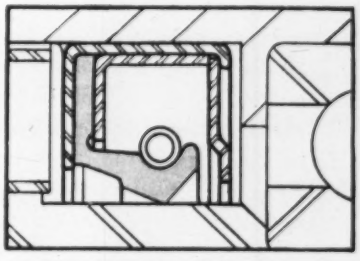
Every Willys Military Jeep has a "transfer case" which provides for 2 functions: (1) Engaging the front axle drive; (2) Engaging the emergency low gear ratio. Spicer uses dependable Garlock KLOZURES to protect the front and rear bearings on the output shaft of this important mechanism.

Spicer uses KLOZURE* Oil Seals

The Spicer "transfer case" in a Military Jeep must be able to function smoothly under the most adverse operating conditions. Thus, the bearings on the output shaft (which operates at speeds up to 4,000 R.P.M.) need *positive* protection against dust, mud, and water; the bearing lubricant must be sealed in. This job calls for a superior oil seal. Spicer engineers rely on KLOZURE garter-spring Model 65.

Take a tip from Spicer, who for 50 years has been manufacturing precision parts for the automotive industry. Standardize on KLOZURE Oil Seals—the best bearing protection money can buy.

There's a service-tested KLOZURE model for every bearing application. For complete information contact your Garlock representative or write for KLOZURE Catalog No. 10.



Installation of Model 65 KLOZURE Oil Seal on the output shaft bearing of the Spicer "transfer case."

*Registered Trademark

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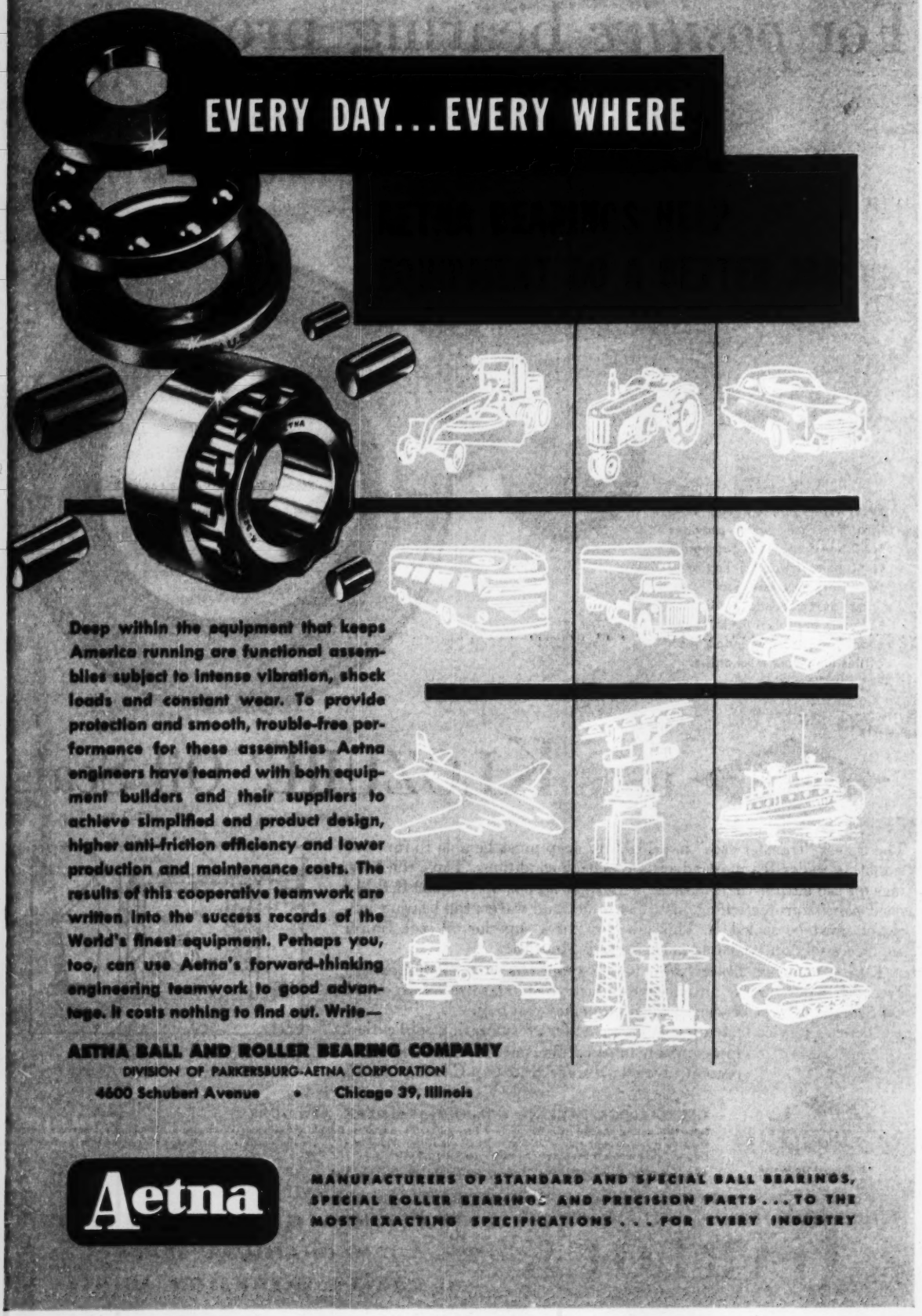
MECHANICAL SEALS
RUBBER EXPANSION JOINTS



Deep within the equipment that keeps America running are functional assemblies subject to intense vibration, shock loads and constant wear. To provide protection and smooth, trouble-free performance for these assemblies Aetna engineers have teamed with both equipment builders and their suppliers to achieve simplified and product design, higher anti-friction efficiency and lower production and maintenance costs. The results of this cooperative teamwork are written into the success records of the World's finest equipment. Perhaps you, too, can use Aetna's forward-thinking engineering teamwork to good advantage. It costs nothing to find out. Write—

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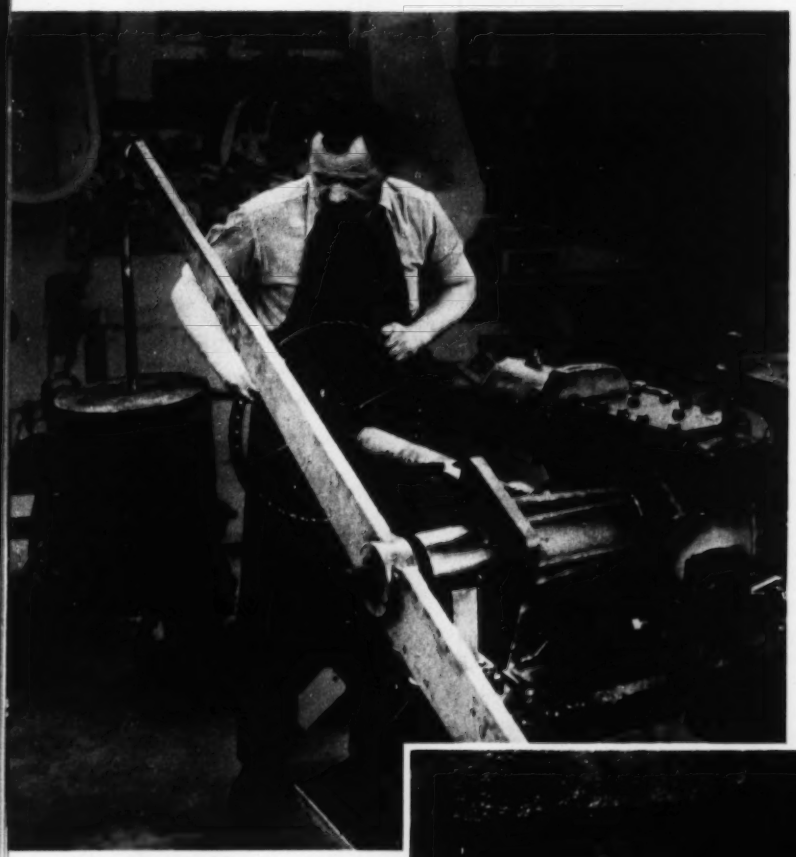
New facts for your file on

USS CARILLOY STEELS

USS Carilloy steels minimize distortion in power steering units for cars

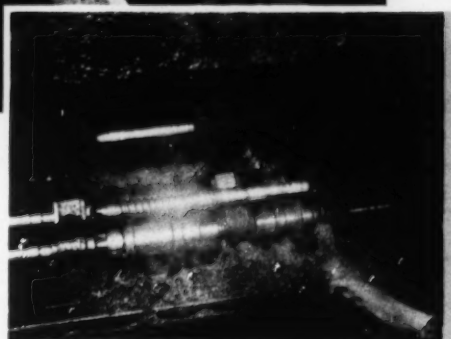


Torque Testing of completed steering unit. Even the heaviest steering loads require only 3 lbs. pull by the driver of an automobile with power steering. In addition, road shocks are cushioned by the power steering unit.

POWER steering units are precision machines. Every part must fit exactly. Parts must be interchangeable. They must be made to finished tolerances as small as .0001". They must be heat treated with minimum distortion.

These rigid requirements dictate the use of accurately controlled *alloy* steels that can be *quenched in oil*. These steels must respond uniformly to heat treatment, time after time, so that many thousands of parts can be made —*all exactly alike*. USS CARILLOY steels are used extensively in power steering units because they help to insure the uniformity that is essential in all critical parts.

CARILLOY steels are giving excellent service daily in a wide variety of precision parts for automobiles, aircraft, trucks, farm equipment, construction machinery, rotating machines, and many other applications. These high quality steels are meeting some of the toughest requirements known to industry. They can meet yours. For information write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.



Worm Shafts are ground to within .0005". Alloy steel must be used for these parts so they can be quenched in oil with a minimum of distortion to maintain the close tolerances.

Heat Treatment. USS CARILLOY steels have the uniformity in response to heat treatment that is so necessary to obtain the high strength, adequate ductility and minimum of distortion required in power steering units.

USS

UNITED STATES STEEL CORPORATION, PITTSBURGH · COLUMBIA GENEVA STEEL DIVISION, SAN FRANCISCO

TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST TO COAST

UNITED STATES STEEL

New facts for your file on

USS HIGH STRENGTH STEELS

Roof purlins of USS COR-TEN steel are 28% lighter, cost 17.5% less than carbon steel

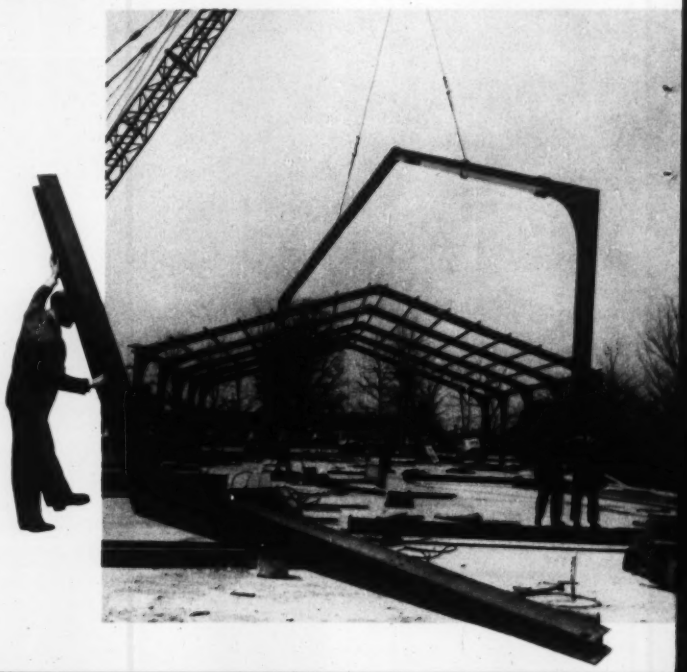
● By taking advantage of the higher strength of USS COR-TEN steel, The Steelcraft Manufacturing Company, Rossmoyne, O., manufacturers of Standard Steel Buildings, was able to substantially reduce both the weight and the cost of the purlins used in the rigid-frame steel buildings they have made for the U.S. Government and for commercial and industrial use.

Although the 20-ft. purlin sections made of 14 gage USS COR-TEN steel have the same load carrying capacity as 12 gage carbon steel, they are 30.4 lbs. lighter and cost $2.63 less each.

The manufacturer estimates that the rigid-frame construction itself reduces cost about 20% when compared to conventional construction, and when COR-TEN steel is used, costs are still further reduced about 25%.

USS COR-TEN steel also ensures other important economies. Its lighter weight not only makes handling and assembly easier but materially reduces freight costs, both when the steel is shipped from the mill and again when the building sections are transported to the erection site.

Because COR-TEN steel has 4 to 6 times the resistance to atmospheric corrosion as carbon steel, and because paint adheres more tightly to it, the COR-TEN steel purlins will outlast ordinary steel construction and require minimum maintenance through the years.



USS MAN-TEN steel reduces weight, assures greater strength and durability in Cardwell "Trailerig"

● Extreme portability which keeps moving costs to a minimum is obtained in this well-known portable oil drilling rig which combines the draw works assembly, including the mast, with the trailer frame.

This compact, completely unified machine has capacity for 5,000 foot slim hole drilling and 10,000 foot workover. It carries a 90- or 96-foot mast which can be telescoped and folded down so that the "Trailerig" in roading position is only 8 feet wide, 13½ feet high and 59 feet long.

To keep weight as low as possible without sacrificing ruggedness, the Cardwell Mfg. Co. of Wichita, Kansas, has built the bridge-type trailer frame and working platform of high strength USS MAN-TEN steel and reduced weight 6,000 lbs. as compared to carbon steel construction.

Additional weight has been saved in the mast in which all structural members are of 8" x 11.5 lb. MAN-TEN steel channels. These are considerably lighter than if carbon steel of equal strength had been used.

But USS MAN-TEN steel does more than save weight in this construction. Its higher fatigue strength—40% greater than carbon steel—and its greater strength and abrasion resistance pay off in increased durability which minimizes maintenance and helps to keep the "Trailerig" steadily on the job when making hole.

USS

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND · COLUMBIA GENEVA STEEL DIVISION, SAN FRANCISCO
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UNITED STATES STEEL

New facts for your file on

USS STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

Stainless Steel milk dispensers fabricated at rate of 120 units per day

BY UNITED REFRIGERATOR

The experience of United Refrigerator Company, Hudson, Wis., shows how adaptable Stainless Steel is to mass production operations. Milk dispensers—used for serving cold milk in glasses in schools, restaurants and the armed services—are being fabricated from Stainless Steel at a rate of more than 120 units per day.

United uses no special equipment in fabricating Stainless Steel. Such operations as shearing, punching, notching, braking, soldering, spot welding and grinding take place on equipment used for fabricating mild steel.

Shop practices are much the same, too. Blades are kept a little sharper, dies a little smoother and greater care is exercised to prevent marring the smooth surface of Stainless.

The result is a product with a high degree of sales appeal . . . made from a material perfectly suited for the sanitary nature of the application.

Stainless Steel milk dispensers after assembly at United Refrigerator Company.

Polishing the inside of a 30-quart bowl at ACF Industries.

Mixing bowls –12 to 160 quarts– drawn from Stainless Steel

ACF Industries, at its Milton, Pa. works, fabricates a line of industrial mixing bowls used by bakeries, restaurants, chemical plants, cosmetic manufacturers and the like. Depending on service conditions, the bowls are of carbon steel or Stainless Steel. But the same fabricating equipment is used for both.

Fabrication of a 30-quart Stainless bowl begins with two draws on a 1000-ton hydraulic press. The 31½" circle is first reduced to 20" and then to 14½" making a bowl 15" high. Stainless used is 16 gage.

The bowl is then annealed and pickled, the flange is trimmed, it is spun and beaded on a lathe, the outside is polished, handles and fittings are welded on and the inside is polished.

Even dies are used interchangeably between carbon and Stainless. Stainless requires only a little more careful handling.

Stainless Steel is not difficult to fabricate -it's just different

You pay no penalty in shop procedure to obtain the outstanding sales benefits of Stainless Steel. You can usually use the same equipment used for carbon steel with the addition of a little more power and a little more care.

So put Stainless Steel into your designs and into your selling. Our representatives will be glad to help you select the proper grade and fit it to your fabricating procedure.

USS

UNITED STATES STEEL CORPORATION, PITTSBURGH · COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
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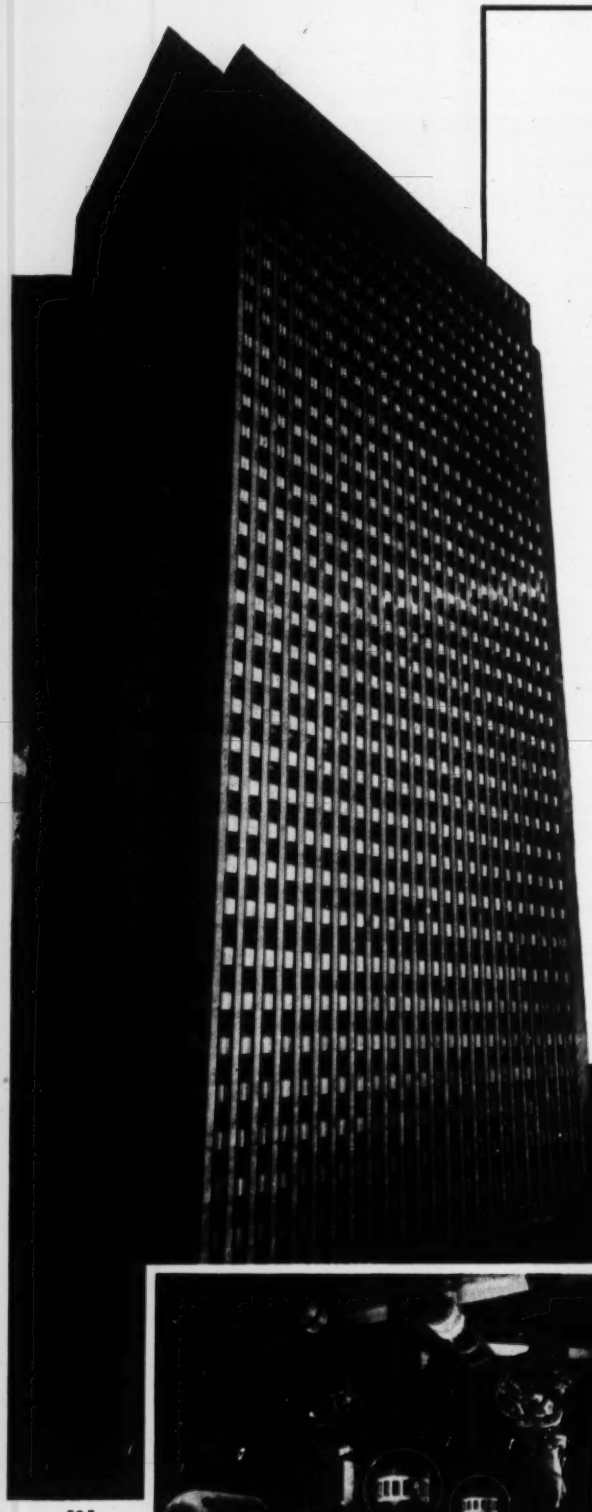
UNITED STATES STEEL



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Piping systems of some of the world's most famous buildings are "safe and silent"—free from the damaging vibration and noise caused by *water hammer*—due to the installation of Williams-Hager Check Valves. This is a high tribute, you will agree, to their superior quality and dependability. A tribute, which we believe makes them worthy of your consideration when specifying check valves for assured protection of your piping systems.

Write for Bulletin 654

CHECK VALVES

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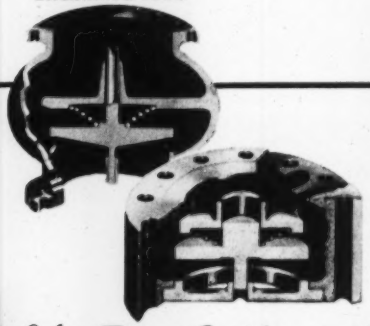

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IN WHICH WILLIAMS-HAGER VALVES HAVE BEEN INSTALLED

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Hotel Waldorf Astoria, New York, N.Y.
Alcoa Building, Pittsburgh, Pa.
Hotel Drake, Chicago, Ill.
Rockefeller Center Buildings, New York, N.Y.
Fidelity Philadelphia Trust Building, Philadelphia, Pa.
Hotel Astor, New York, N.Y.
Metropolitan Life Insurance Building, New York, N.Y.
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Chicago Tribune Building, Chicago, Ill.
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New England Mutual Life Insurance Building, Boston, Mass.
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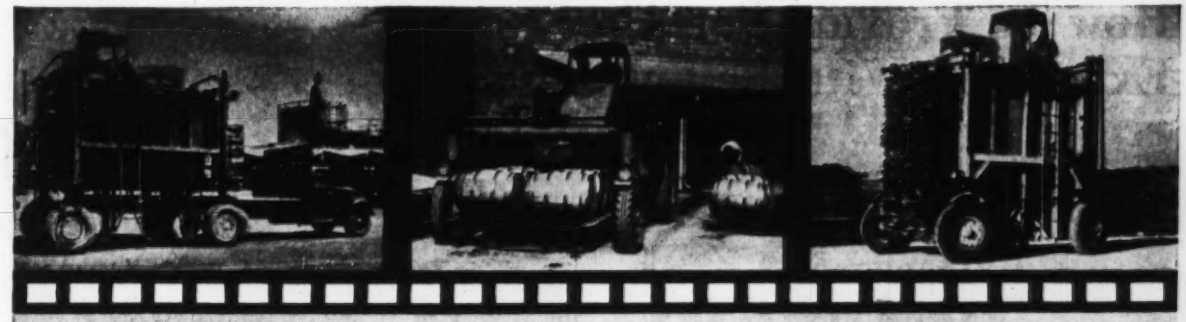
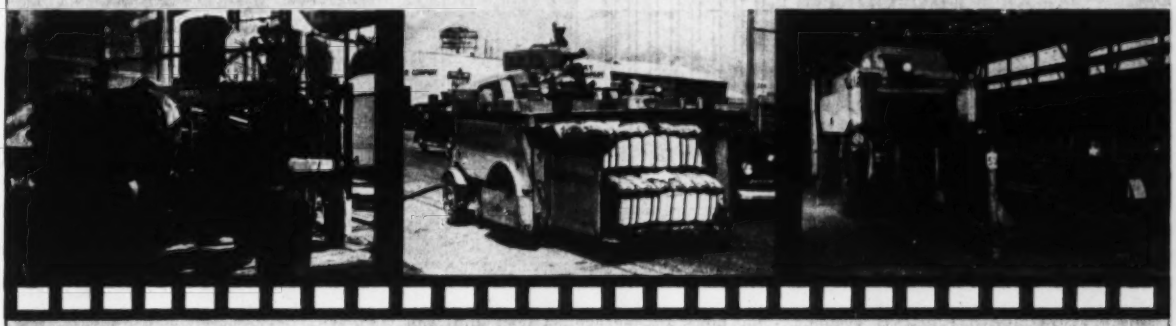
U.S. Steel Corp. Building, New York, N.Y.
Daily News Building, Chicago, Ill.



One man loads it . . . in 3 seconds, up to 50,000 lbs. . . .



One man drives it . . . speeds up to 56 mph

One man unloads it . . . in 3 seconds

You are invited to a free showing of

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a 25-minute sound movie starring the **ROSS CARRIER**

You can revolutionize your handling operations! You can move materials faster, farther, at less cost, and this new movie shows you how to do it. As in the above pictures from the film, you'll see the Ross Carrier handling pineapples, whiskey barrels, lumber packages, heat exchangers, cotton bales, steel tube—for aggressive, cost-conscious companies which have discovered the unique advantages of over-the-load handling. If you are sincerely interested in knowing what's new in materials handling, you won't miss this free movie. It's available on a loan basis—simply send the coupon to reserve your showing. We'll mail the film to you—your only cost is return postage.

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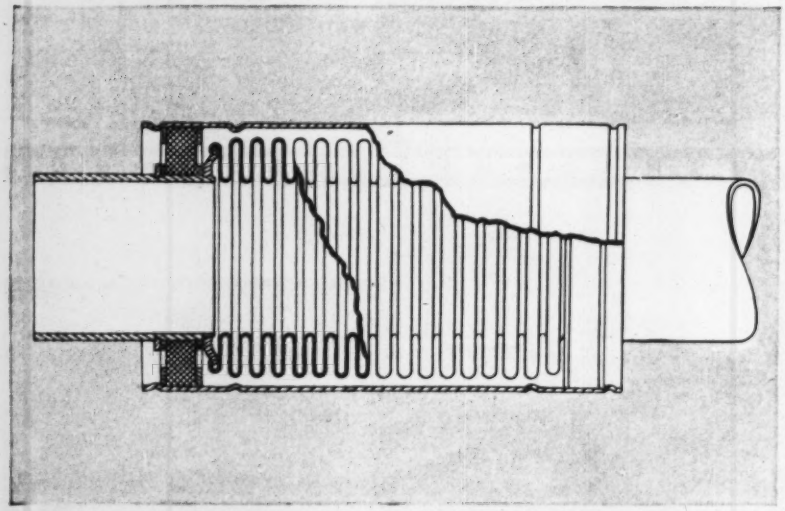
How To Provide For Thermal Expansion With Bellows Devices



Expansion joint employs flexible, leakproof bellows to compensate for rapid thermal changes accompanying heating cycle in baseboard radiation systems. Bellows is free to move within protective shield, absorbing pipe expansion. Device eliminates source of common complaints arising from noise produced by expanding pipes grating against floor and wall timbers.

One of the simplest ways of providing for thermal expansion and contraction in fluid systems is through bellows devices incorporated in the original design.

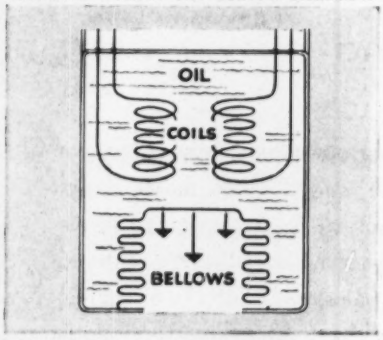
Where heating and cooling of fluids would ordinarily add unwanted stresses or even result in buckling or failure of members, the presence of a leak proof, flexible bellows properly located in the system compensates for dimensional changes. In addition, bellows flexibility permits a certain degree of misalignment to be tolerated without difficulty.

This latter factor can sometimes represent important savings in production since the need for time consuming, precise, "lining up" of elements is eliminated.

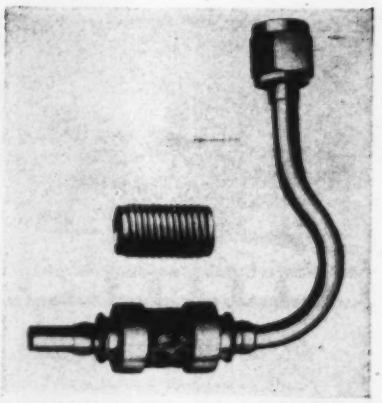
New Expansion Joint employing bellows as the flexible element solved a serious problem for manufacturers of baseboard radiation systems. Developed by the Clifford Manufacturing Company, the bellows joint takes up the expansion and contraction of the pipes with the heating cycle and eliminates the objectionable noises that result from pipes grating against floor and wall timbers.

Flexible Jet Manifold Assembly utilizing a stainless steel bellows as the flexible element solves a high temperature problem for jet engine manufacturers. Two benefits result: dimensional changes are compensated and easy, leakproof assembly of flare fittings can be made without concern for a small degree of misalignment. The protective metal braid and high strength stainless steel bellows make a mechanically rugged joint. Pressure rating is 1000 psi.

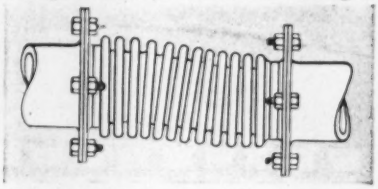
Hermetically Sealed Aircraft Transformers employ a built-in bellows within the sealed chamber



to compensate for expansion and contraction of the oil fill with temperature changes. The bellows thus prevents the development of high pressures within the unit and at the same time maintains a leakproof hermetic seal.



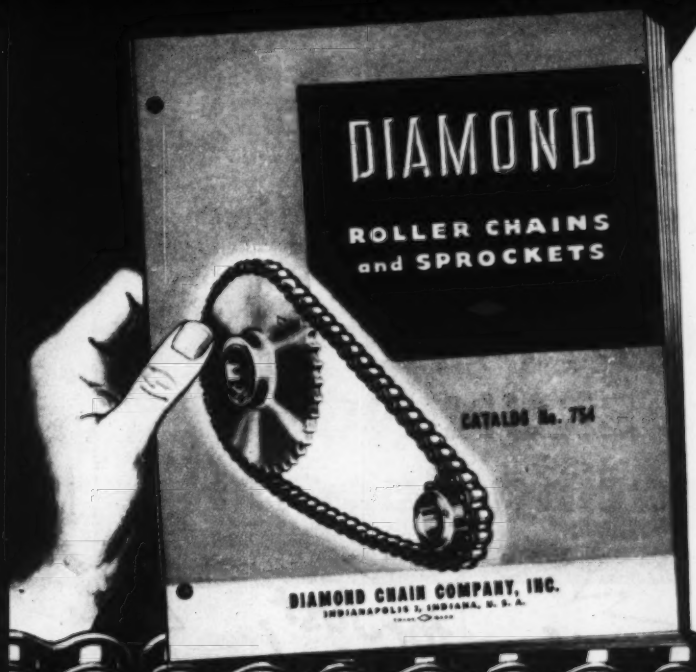
Flexible manifold assembly is designed around a stainless steel bellows for high temperature and anti-corrosion service. Flexibility of bellows simplifies alignment, permits easy, leakproof assembly of flare fittings and allows for thermal changes.



Flexible Piping and flexible connectors are other applications where bellows allow for thermal expansion and mechanical displacement. In high temperature piping systems for example, bellows connectors absorb expansion and contraction and permit lateral motion of pipe supports with respect to one another. In aircraft applications, flexible bellows connectors are employed in hot air de-icing systems where flexing of the wings requires equivalent flexing of the ducts.

Your Design Problem involving thermal compensation or mechanical misalignment may be solved with a bellows device. Clifford will be glad to offer engineering help. Simply sketch the controlling dimensions and specify the service conditions. We will help you arrive at a proper design and produce in quantity to your specifications.

Write: Clifford Manufacturing Company, 144 Grove Street, Waltham 54, Massachusetts. *Division of Standard-Thomson Corporation.* Sales offices in New York, Detroit, Chicago, Los Angeles and Waltham, Mass. 7.4.23



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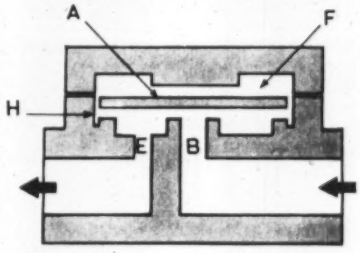
Thermodynamic
STEAM TRAP

ACTUAL SIZE

this new trap virtually eliminates maintenance

SOLID STAINLESS STEEL DISC ACTS AS VALVE HEAD

HERE'S HOW IT WORKS!



Air and/or condensate raise valve seat disc A, discharge thru E. When steam follows, greater velocity causes it to strike body at H thus building up pressure in chamber F. This causes disc to seat, closing tube B. As pressure in F decreases by condensation, pressure in tube B raises disc and cycle is repeated.

The Sarco Thermodynamic Trap has proved successful on steam mains and separators; headers and soot blower pipes; engine and turbine stop valves, separators and casing drains; alternate heating and cooling applications.

2098-B

A solid stainless steel disc—practically indestructible—is the only moving part!

Most striking feature of the Sarco *Thermodynamic* Trap is its simple maintenance-free design. There's only one moving part – a solid stainless steel disc that practically lasts forever. There are no other moving parts to wear out or cause trouble.

Condensate, air and steam act directly on the disc valve which opens to discharge condensate and air – snaps shut to contain steam. There are no mechanical devices required to operate valve (see diagram at left). That means practically endless trouble-free operation.

Other advantages: small size, easy installation, not affected by shock or vibration, immunity to corrosive elements with all wearing parts stainless steel, same valve head and seat for all pressures to 600 psi and temperatures to 950° F.

Check these advantages to your own satisfaction at absolutely no cost. We'll send you a trap for trial. All you do is fill out the coupon and mail it in.

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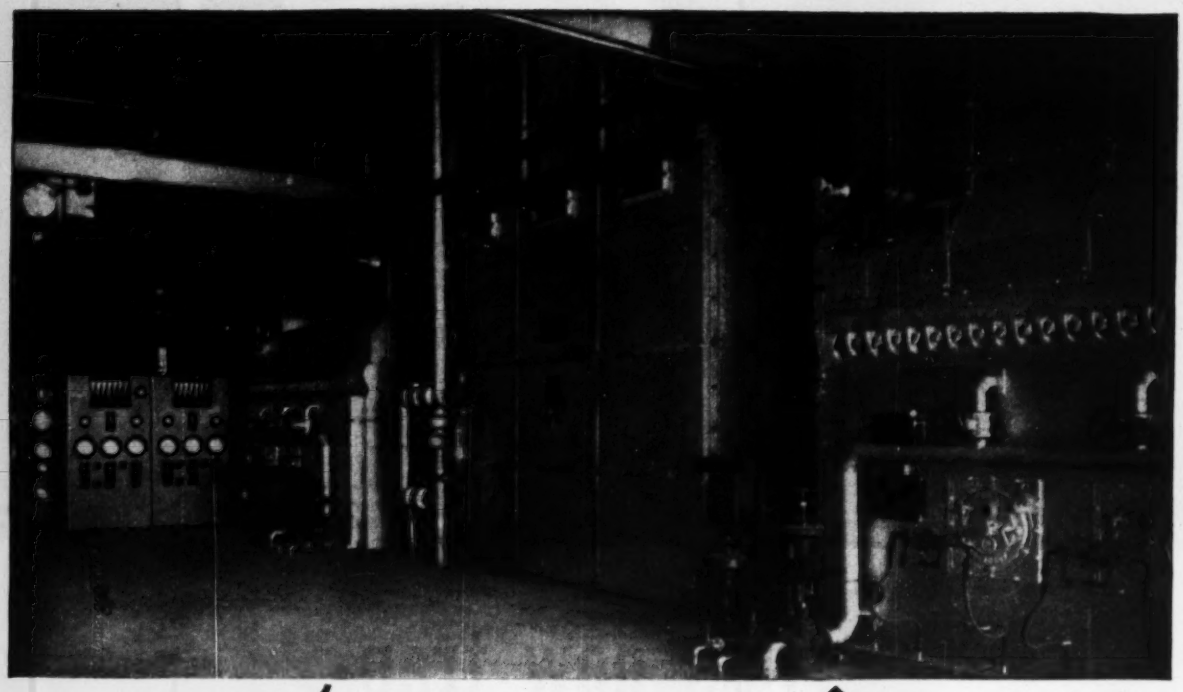

Boiler room at Kansas State College. Republic instrument panel is at left. Boilers are arranged for either gas or oil firing.

REPUBLIC *Automatic* COMBUSTION CONTROLS

Go to College to Cut Steam Costs

● At Kansas State College, a complete Republic combustion control system, feedwater level controls and instruments automatically operate two 50,000 pounds per hour boilers for maximum combustion efficiency. Fired by either oil or gas, these boilers generate steam at 225 psig and 500°F.

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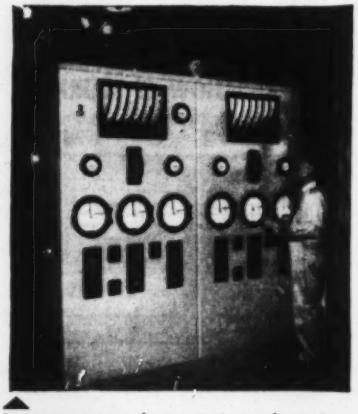
Whatever the size of your boiler, its draft arrangement, type or types of fuel to be fired and load conditions to be met, there's a Republic combustion control system that can bring these advantages to you. Our engineering staff, with more than 37 years *specialized* experience in combustion control systems, is at your service to help you get the system that exactly meets your needs. For your convenience, there's a nearby Republic field engineer to bring you all the facts. Write and make a date to see him soon.



Instruments on the control panel monitor boiler operation. If desired, the entire combustion system can be operated manually from this panel.

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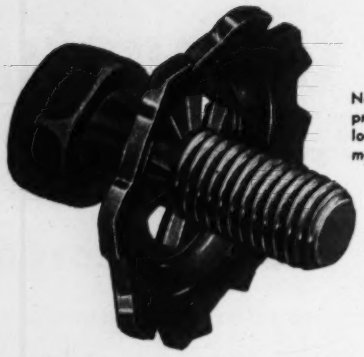

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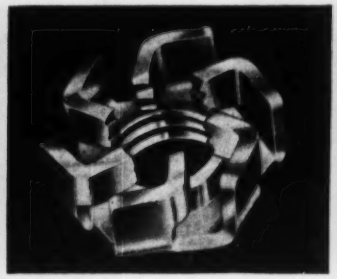

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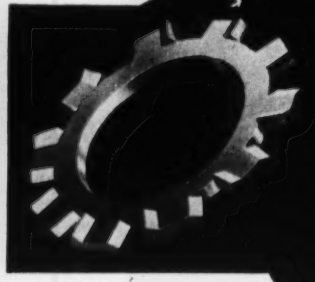

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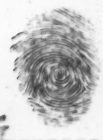

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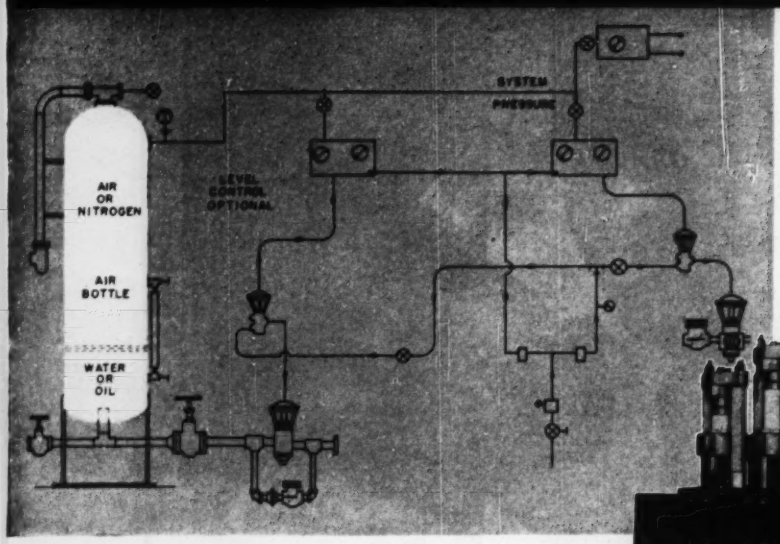

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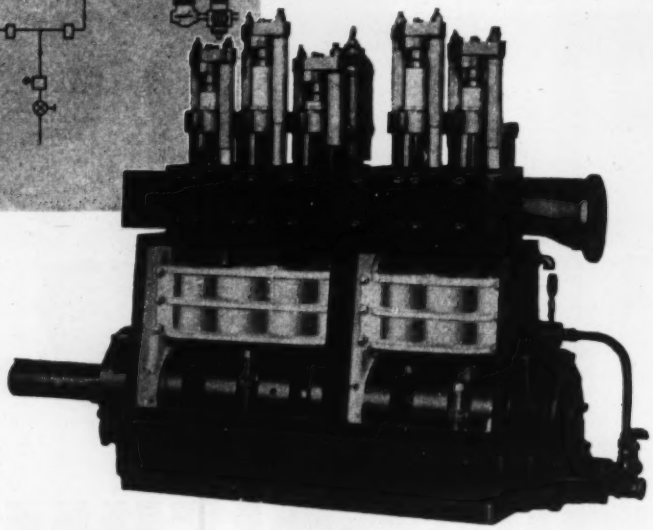

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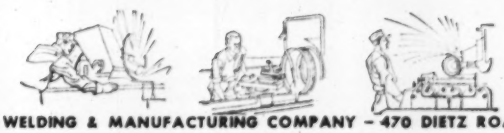

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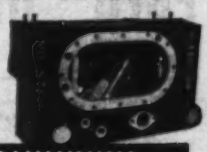

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Cobalt base alloys such as N-155.

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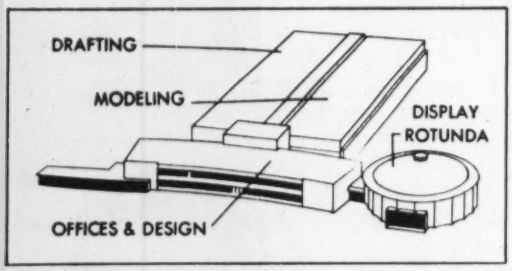
Advanced Styling Section of Ford Motor Company's new $11.5 million Styling Building, Dearborn, Michigan.

Ford "dream shop" has built-in climate!



The design-office wing and display rotunda are served by a central system. It includes: 7 supply fans; 34 exhaust fans; heating and cooling coils and sprayed-coil dehumidifiers — all furnished by American Blower.

Air for drafting rooms and modeling studios is conditioned **by 24 specially built**, automatically controlled American **Blower Air-Conditioning** Units. Each unit contains heat**ing and cooling** coils and Capillary air washers.

This "dream shop" at the Ford Engineering Staff's Advanced Styling Section is just one of many styling areas which depend on clean, conditioned air.

For example, in 12 roomy studios clay-modeling teams work under lights which produce shadowless illumination — and intense heat! To absorb this heat and provide the proper climate for working with clay models, specially designed air-conditioning systems were installed for each studio and drafting room. American Blower Air Handling and Air-Conditioning Equipment was used for this unusual assignment.

The expert know-how of American Blower engineers is on tap for industry at all times. If you have an air-handling or air-conditioning problem, phone your nearest American Blower or Canadian Sirocco Branch Office.

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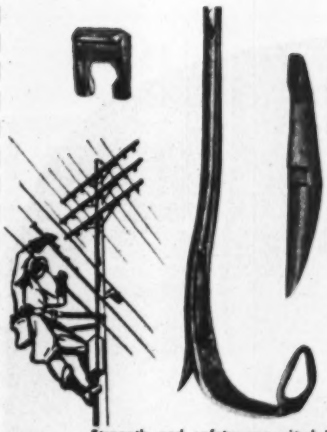
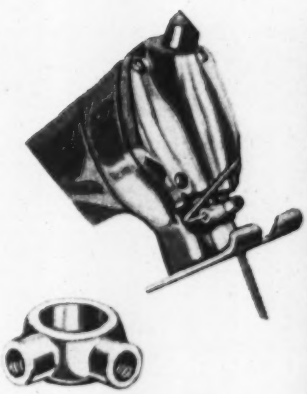
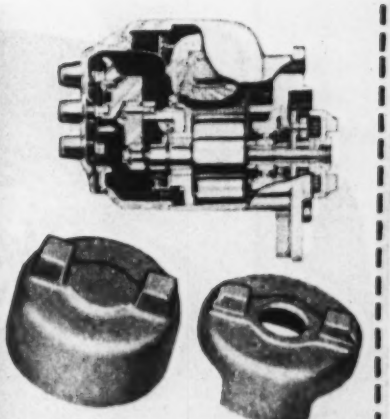


Strength and safety are vital in rugged pole climbing service. Forged parts possess all the inherent qualities necessary for light weight design and performance stability.



The exact size of this forged blade clamp on this versatile hand tool is 7/8" over-all width. Small forgings can be produced to exceptionally close tolerances—which means economical production with the highest obtainable degree of toughness and strength.



Forged drive cup for magneto impulse starter—forging this part in closed dies controls flow lines in the metal. Maximum resistance to strain exactly where it is needed is typical of why forgings stand up under shock or torsional stresses.

SMALL FORGINGS THAT DO A big job

Engine cowl and mounting bracket are typical of how lighter and thin sectional parts maintain the strength-to-weight ratio by forging.

A unique forging, only 1 3/16" long, does an important job as used in a stock exchange indicator. Subjected to direct impact load each second, it is required to last 20 years.

Forged parts, regardless of size, yield the combined advantages of strength, a greater factor of safety, and shock-resistance. The smallest of forged parts requiring important functional and precision demands more than meet desired specifications—*a major importance to your product application.* Consult a forging engineer. His experience will be helpful to you with your part design analyses—he symbolizes service without obligation.

DROP FORGING ASSOCIATION
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This book tells why forgings are used for the toughest work loads. Engineering, production and economic advantages obtainable with closed die forgings are presented in this reference book on forgings. Write for copy today or attach coupon to your business letterhead.

A new full color 33 min., 16 mm. Movie entitled, "Forging in Closed Dies," reveals all aspects of the closed die forging process of forming parts. Represents over ten years of planning and research. The film is effective before many types of audiences, including technical societies, college engineering classes, purchasing agents, and similar groups. Write for information about loan of film without cost.

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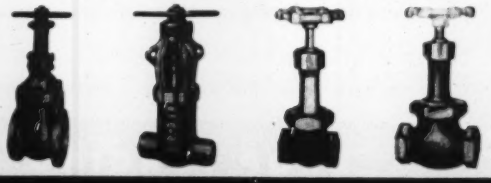

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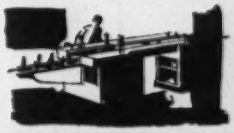

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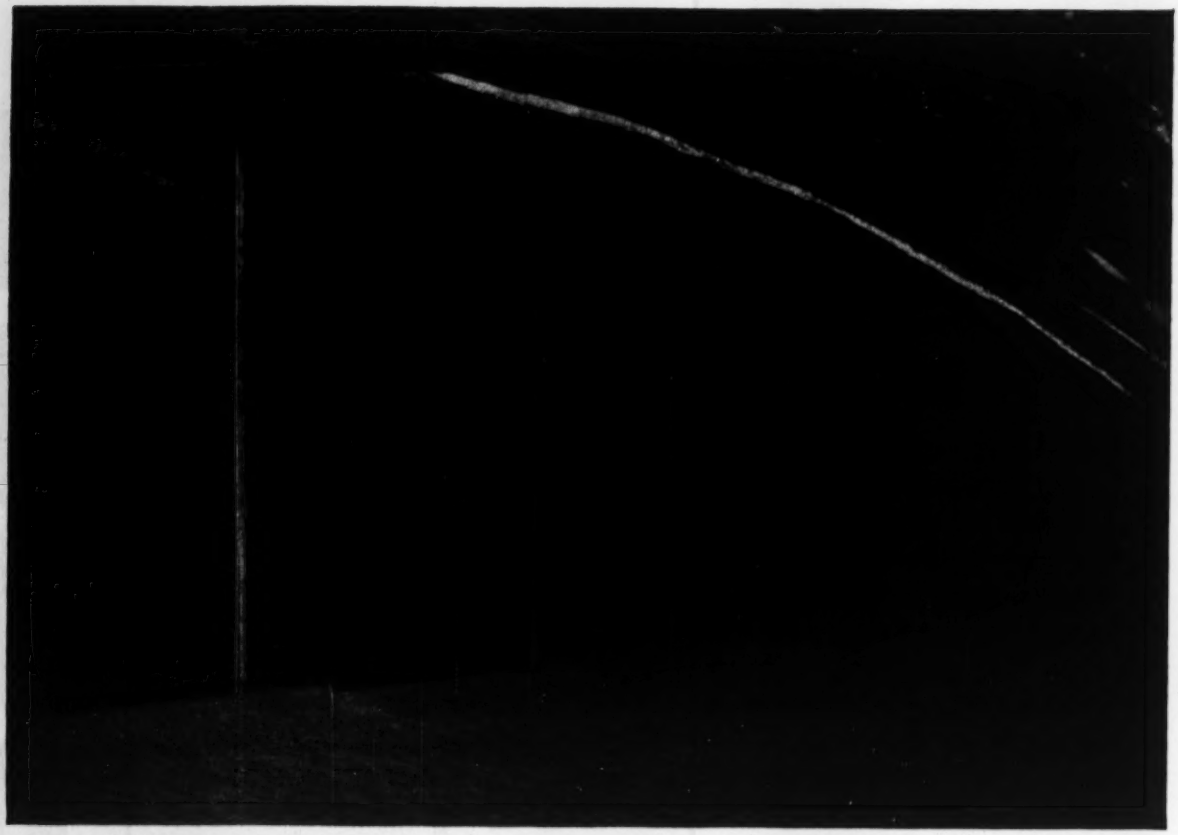

Tunnel within a tunnel — 8500-ft. exhaust ducts along the top of each Holland Tunnel tube are supported in the middle by 7-ft. lengths of 2½-inch by ⅜-inch hot-rolled Monel flats. These hangers are installed every 8 feet.

The Holland Tunnel that drivers never see

How it's supported by corrosion-resisting Monel hangers

Drivers never see *this* tunnel because it is hidden above the ceiling of the Holland Tunnel.

This tunnel-within-a-tunnel provides a unique air exhaust system that completely changes the air in the Tunnel every minute and a half. Since the Holland Tunnel was opened in 1927, it has proved so successful that designers of the Lincoln Tunnel and other large tunnels have followed the same design.

In working out this unique exhaust system, Port of New York Authority engineers faced the problem of providing support for the tunnel ceiling (the exhaust duct floor). In order to minimize wind resistance, center support members or hanger rods from the cast iron tunnel shell to the ceiling had to be as thin as possible.

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A recent check showed these thin Monel hangers in as good condition as when installed. *No corrosion after 27 years, despite dampness and the continuously high concentration of corrosive engine fumes in the exhausted air.*

When *you* have a design problem involving corrosion and other destructive conditions, one of the Inco Nickel Alloys like Monel usually permits you to insure long service and, at the same time, to limit weight and bulkiness.

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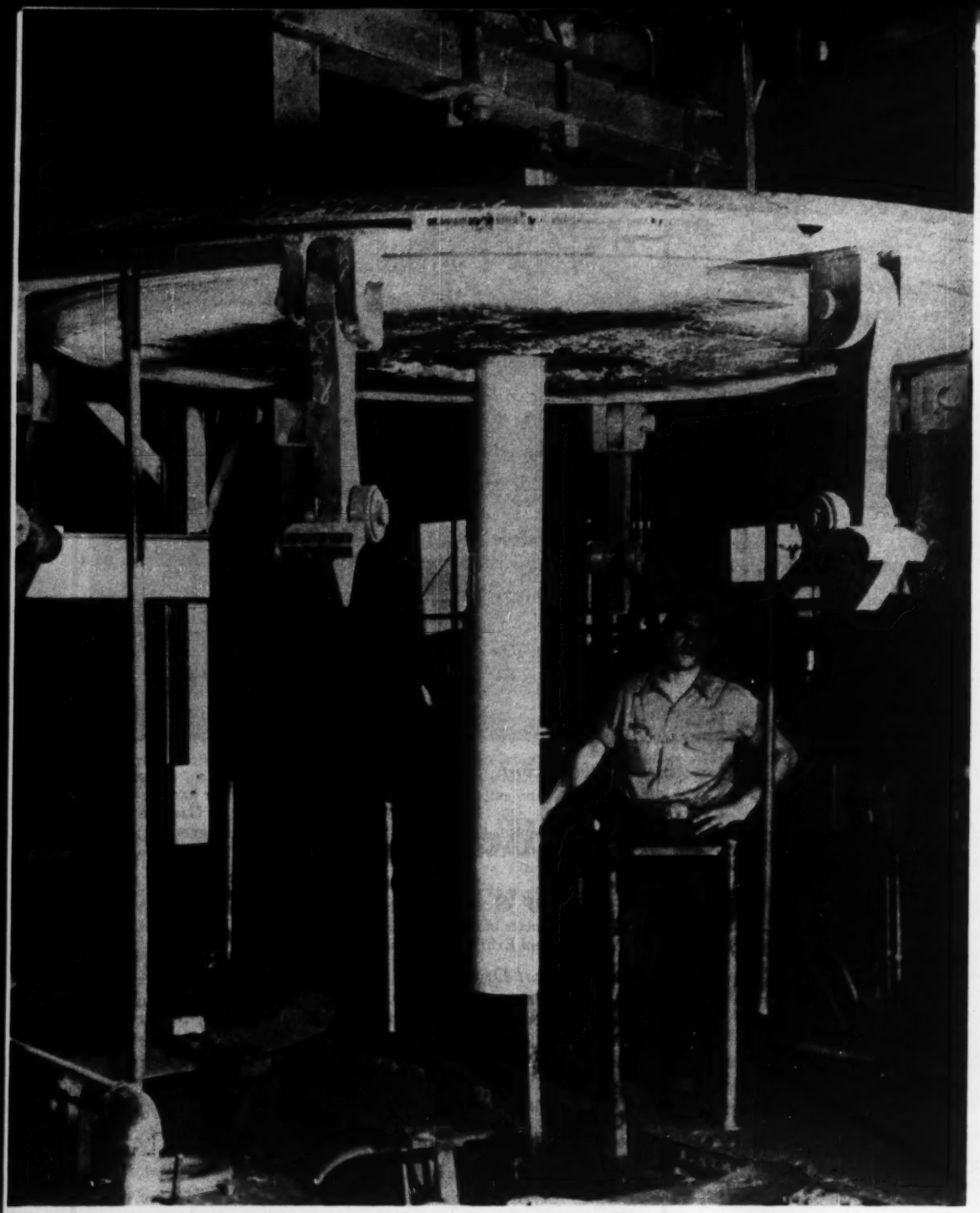

This giant six-foot ceramic pouring tube . . .

. . . that can stand up under extreme temperature changes, has been developed for a new pressure-casting method for carbon steel, by Electro Refractories & Abrasives Corporation, Buffalo, N. Y. The steel is pressure-poured into graphite molds for railroad freight wheels. Compressed air forces the molten steel upward through the tube into the mold cavities. Temperature differentials may reach as high as 2000 F at opposite ends of the tube. It is being used at Griffin Wheel Company, Chicago, Ill. See also "Pressure-Pouring Steel Car Wheels," Mechanical Engineering, February, 1954, pp. 152–158.

Editorial

MECHANICAL ENGINEERING

October, 1954, Vol. 76, No. 10 . George A. Stetson, *Editor*

Machines Need Men

In an address, "The Apprenticeship System in Modern Life," delivered by Ralph E. Flanders, past-president and honorary member, ASME, before the Tenth Annual Eastern Seaboard Apprenticeship Conference at Manchester, Vt., on May 28, 1954, the distinguished U. S. Senator and industrialist recalled his own early training.

"On Jan. 14, 1897," he said, "I began an apprenticeship in the machine-tool shop of the Brown and Sharpe Manufacturing Company of Providence, R. I. It was an old-fashioned apprenticeship. I was legally indentured. I was bound to finish out my term of training, and to make sure that I did so, my father was required to post a cash bond of $100 to be forfeited should I leave before the completion of my term. . . .

"That apprenticeship," he continued, "was perhaps the most important part of my formal education outside of the high-school course which I had just completed and in which I learned the rudiments of physics and mathematics. It was education in the true sense. It opened up new lines of knowledge and enlarged my imagination to new experiences and relationships. Particularly it brought me into the world of work which is something that the college graduate may never get or may get at a period so late that it does not leave its impress upon him."

Turning to the "continued need for, and usefulness of, apprenticeship training," Mr. Flanders said:

"The thought might easily come to one that the new automatic machinery we are hearing about will limit the demand for skilled craftsmen. Particularly might this be true in the extreme developments which relate to what is popularly called push-button production, but which the eggheads call cybernetics. This is not the case. . . . .

"The elaborate mechanism," he said, talking specifically about the automobile-production line, "has to be kept in repair. From time to time it is shut down and put back into new condition again. More than this, all of the hundreds of tools which it carries and which operate on the work have to be resharpened or replaced. No ordinary machine takes care of this operation. Thirdly, the machine has to be set up in different ways by skilled craftsmen when it changes from one design of chassis to another; and finally, in an adjoining building are scores of mechanics making and repairing the fixtures and making the tools which go into the production of the wide variety of chasses for which the machine can be and has to be adapted. The skilled mechanic may be absent from the floor of this automatic shop but he is present somewhere else and unless he is there, eventually the machine runs down to a grinding stop and the mechanic has to be sent for. . . .

"As to the continuing need for trained artisans, we find evidence in some census figures which have been recently released. In the 40 years from 1910 to 1950, the percentage of semiskilled workers in the manufacturing industries has increased from 15 per cent to 28 per cent. This of course was due to the increase in automatic machines and the handling of materials in factories and out of doors mechanically, rather than by the back muscles of the common laborer. But at the same time the number of skilled workers increased somewhat, rising from 12 per cent to 14 per cent. This is plain evidence of what I have just been saying. Namely, that the need for skilled workers does not grow less as more and more efficient and elaborate production machinery is installed. Instead of that, the need continued to increase even though slightly."

The testimony Mr. Flanders has given and the evidence he has adduced to show that machines need men applies specifically to apprentice training and to skilled mechanics. But similar conditions exist in all other phases of our national economy and in the professions and at all levels of education. A dynamic society demands backgrounds of education and training that fit men to make rapid adjustments to changed conditions which come, not in slow-moving centuries of drudgery in which the reward of industry is long hours of work and a low level of material satisfactions, but within a relatively few years, and with shorter hours of labor, an abundant production, and ample opportunity for refreshment and development of the physical body and the human spirit.

The necessity to adjust ourselves to a dynamic way of life is imperative. Particularly in a world which is only partially, and that part imperfectly, adjusted to change and is still discovering its hazards and benefits, we must keep moving to keep alive.

There is no profit in a release from physical labor or in an economy of abundance if, in a partial attainment of them, we imagine ourselves relieved of the responsibility of further progress, and hence, through indolence and indifference, lose all. Machines need men, yes, and so also does our way of life.

Creative Engineering

Practice of a new aspect of engineering—that of creating new visualizations of engineering principles

By Crosby Field

President, Flakice Corporation, Brooklyn, N. Y.
ASME Medalist, 1953; Fellow ASME

THE relatively new term "creative engineering" gradually is carving out a place for itself in our language. Continued use undoubtedly will create a concept quite definitive, which presumably will exclude mechanical, chemical or electrical invention on the one hand; and on the other, that part of engineering not involved in the actual act of creating something new. In the meantime, since I find myself not fettered by authoritative definition, I may suggest one, and then deal with what I have found to be some important aspects of special interest to the practitioner of the art.

What is the greatest achievement of the creative engineer? He and his fellow engineers have removed the need for human slavery. He has given us the "iron slaves" to do much more cheaply the work required by a civilized society, and human slavery has become uneconomical. For the first time in history, therefore, it has disappeared in our Western World.

What Is an Invention?

In the last analysis the term "invention" is purely a legal abstraction and, as such, is being redefined continually for us by the Patent Office, the Federal Courts, and ultimately, by the Supreme Court of the United States. Since that honorable body is subject to political and social-thinking influence, we find our legal gage for invention constantly changing! Nevertheless, even a short study will discover the fact that inventing is an art. As an art it is a form of human expression. To quote:[1]

"What is mechanical invention? Is it engineering? No! But it utilizes engineering. Is it mathematics? No! But it needs mathematics. Is it science? No! Science is the cruel stepmother—willing to help feed and nourish the child at times; she is more frequently ready to prove by tradition, and her so-called 'accepted-facts' convention, that the child is a sport and should not survive. . . .

"One attribute mechanical invention has in common with other forms of art is in the fact that its creations are visualizations. This visualization is threefold: first, the actual figures or outlines that are the denotative aspect; secondly, the connotative envisionment of moods and other intangible forces; and finally, there is ever present, even though it is so abstract that it cannot be termed even connotative, that visualization of the effect of the work on the sum total of human activities. And all these three expressions of the visualization must be present in the object of the expression of the art, ere we can call it truly art.

"It is chiefly in the last two aspects that the mechanical invention differs from the painting (considering the painting of course as another form of art) and this difference is due mainly to the concreteness or reality of the effects of this visualization. The picture requires the interpretation of the man to create the concept of these two aspects; prior to the birth of the machine, while it is still in the picture stage, the man is required, but once born, once a real machine, the man is thrown aside; the machine itself interprets the threefold aspects of its visualization in which all the effects will follow, regardless of the presence of the human interpreter."

Many are the forms of expression in which each form has developed into a technique established by a group of individuals working in the same general field of expression. Such a technique is recognizable as an art.

Is it invention to develop a new theory of design? A new method of stress analysis? A new compilation of widespread data, to organize it and present it for the use of engineers? Is it invention to lead our profession by editorial foresight and guidance, or by evolving a system of pedagogy that trains and inspires engineers? Is it invention to devise an organization or a method of operation of factories or of equipment?

Surprisingly enough, the answer to all of these questions is, No. Yet, each is a creation, each involves visualization, and each uses engineering principles. Nevertheless, it is not invention as defined in the law. If it be not invention, then, what is it?

Each example given certainly involves the use of constructive imagination. Each is practiced by a sufficiently large group to have evolved a recognizable technique; each is, therefore, a form of art.

All have two attributes in common; their practitioners must be creative, and they must use engineering. The term creative engineering is, therefore, a correct definition of their activities and a proper and fitting name for their art.

Address given at the luncheon of the Machine Design Division, June 22, during the Semi-Annual Meeting, Pittsburgh, Pa., June 20–24, 1954, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[1] "Mechanical Invention as a Form of Expression," by Crosby Field, MECHANICAL ENGINEERING, vol. 50, 1928, pp. 447–453.

May we define creative engineering, therefore, as the act of creating a new visualization of an application of established engineering principles? This does not necessarily include invention because many inventions are made which are not in accord with established engineering principles, nor does it absolutely exclude invention. However, this definition does include the activities of the constructive imagination of those skilled in the art of engineering, applied to new visualizations of any type whatsoever. It certainly does include machine design, even when the particular machine design does not include invention.

There are some, of course, who claim that all engineering by its very nature is creative, and our term creative engineering becomes a mere redundancy. While the functions I have just mentioned, and similar activities undoubtedly are creative, yet it is common knowledge that they are engaged in by a relatively small percentage of engineers. Even these normally find only a relatively small proportion of their time and effort actually occupied by such work. We cannot say, therefore, that all engineering is creative—there are too many examples of engineering that are not.

Creative Engineer Can Befriend the Inventor

What is the usual role of the engineer in connection with an invention submitted to him? To pass judgment upon it; to evaluate it. And how does he do that? By applying to it the standards and formulas of so-called good engineering practice. As inventions rarely fall within such limits unless the invention be of a somewhat minor nature, the natural result is for the engineer to be the adversary, not the friend of the inventor. In every one of the major lines I have pioneered, I have found my greatest obstacle to be the engineer, who always knows why a thing cannot be done, or if it can, why the doing of it is valueless.

That shows one great opportunity for the creative engineer—to be the friend and advocate of the inventor. (The creative engineer and the inventor may or may not be one and the same person.) He will examine the reason for the Engineering Standards and the "good practices" and see whether they should be changed, before casting out the invention for not conforming with them. We must never forget that every engineering practice we have was formulated as the result of many experiments and much experience but it does not necessarily hold in any similar but not identical case.

Both the inventor and the creative engineer, however, are concerned with the determination of the idea for the design. "Whence comes it? It may come from one of many sources but it comes most frequently from the doings of man and principally from the failure to achieve an ideal in those doings. Out of this arises the need for the presentation of something more nearly perfect. Thus we find that the inspiration for the concept of a mechanical invention is the lack of perfection of fulfillment of man's needs by the mechanical world of today."[1]

One early thing the creative engineer must do in connection with an idea, therefore, is to obtain the answer to the question, Is this invention really needed? Honesty compels me to say that in the case of more than nine-tenths of the patents I see issued the answer would be "No." But a negative answer should not be given lightly, without honest study. My experience in judging as an engineer is not unusual; some which I vetoed for my firm became successful under other sponsors.

Why Inventions Fail

What are some of the reasons inventions fail? Many fail because not sufficient creative engineering work has been expended upon them. The invention is worthy, but before the machine will function properly, detailed machine design and redesign oft repeated are needed. When for any one or more of several economic reasons these are not available the invention literally dies "aborning."

Another reason for the failure of a very large number of inventions is that there is no market readily available. The market and a method of economic access to it are something the inventor rarely considers, and the creative engineer all too infrequently. The principal fault lies in the failure to anticipate the shifting in the market that occurs in our rapidly changing age between the concept of the machine and the completion of its development.

One of the most important persons in the chain of development of a machine is the production or shop engineer, without whose planning and designing of special tools the product could never be manufactured at a cost sufficiently low to meet the sales price set by competition. All too often sight is lost of the high degree of creative engineering of this type of engineer and his critical place in the chain of progress. Ignoring him is another not uncommon cause of failure of an invention.

One fact confronts the machine designer every moment, and that is, the ultimate sale of his machine in our present ever-increasing competitive market is largely predetermined by him as he pencils his lines on the drafting board. Help may come from others, all along the line from production engineer and stylist to the salesman battling at the prospect's desk. All these can help but cannot overcome any material obstacle introduced at the outset by the machine designer, often through lack of visualization of its effects on cost, function, or sales appeal during each of the steps intervening between his board and the use of the machine by the customer—and this use includes the cost of maintenance.

An invention usually embodies only one way of accomplishing a result. To ignore the other possible methods is to invite competition, frequently from a superior method. An excellent wholesale example of this type of failure is to be found in the story of the hundred companies exploiting steam-powered automobiles[2] at the beginning of the century—technical successes but they speedily fell before the competition of the internal-combustion engine.

In general, both the inventor and the creative engineer spend too much time in concentrating upon the technical problem in hand, and do not look outside their work to watch sufficiently social and market trends that have a most important influence on their ultimate success. They look too much within, not enough without.

Opportunities for Creative Engineering

The most remunerative opportunity for the creative engineer lies not in the perfection of design of machines already commercial but in the discovery of a new method or in the application of a new material making a new method possible.

Another great challenge for the creative engineer lies

[2] "Old Time Steam Cars," by John Bentley, Fawcett Books, No. 196, Fawcett Publications, Greenwich, Conn.

in the fact that there is a certain volume of production of a given product when a so-called continuous process becomes more economical than a "batch process." Changing over from the latter to the former requires new equipment, often some of it of a nature previously quite unknown in the industry.

We must ever remember when considering continuous versus batch processes, that factory cost is only one element of cost. Distribution costs are the elements which now are ever-increasing and which may even absorb all the savings in a continuous process. On an overall basis several plants throughout the country, using batch processes, may prove more economical than one plant having a volume large enough to justify a continuous process.

For example, consider the ice industry. The refrigerating engineer of 20 years ago evaluated all ice-making processes using only one standard—kilowatt-hours consumed per ton of ice produced. The literature was weighted heavily with the results of huge amounts of so-called "research" on how to reduce costs kw by kw! Yet the engineers of that time reported to Code Authorities of the National Recovery Administration that the early machines for making small ice at the place it is consumed should be prohibited. They claimed that such machines and the new ice product they made had no advantages whatsoever over the then standard large blocks of ice weighing 300 lb each. Today, machines freezing ice in the form of small arched wafers are everywhere, even in small stores, and no one cares much about the kwhr per ton—their justification lies in other factors of cost saving and convenience.

Our creative engineer must ever bear in mind, therefore, that the solution to his problem lies not alone in technical proficiency but requires also a broad knowledge of industry, in general, and, most important, of social and industrial history. Like firing a gun at a moving adversary, he must aim his design at the economic conditions to be expected upon completion of his development, using the present and past only as background—and forgetting not the foreign art!

We are now in an era of decentralization. Centralization and decentralization have ever been in constant struggle—each has certain advantages. The ascendancy of either in any one age is a matter of the economics of the power source. Slave labor tends to centralize, water power to decentralize; steam power to centralize, electricity and internal-combustion engines to decentralize. We are now definitely in an era of decentralization, and fear of atomic missiles will accelerate the trend toward it. One great opportunity for the creative engineer, therefore, for the next decade at least, lies in the design of efficient machines for relatively small production which can be spread throughout the country—example, the "do it yourself" equipment.

Opportunity for Creative Engineers

What opportunity exists for the creative engineer to make his chosen art support him in a style worthy of its contribution to human progress?

Remuneration can come only through employment by others or going into business for oneself. If one seeks employment, which is to be preferred, a large organization such as Government, universities, or big corporations, or small companies?

It is a remarkable fact that each of these three types of organization is developing a distinctive pattern of living, in which the incentives, the attitudes of the personnel, the aptitudes required for success, and the rewards in remuneration and other perquisites are becoming markedly different.

This problem is far too great for more than a mere cursory mention. It has been discussed from many different viewpoints by many writers. Studies of the advantages of each type and the differences between them are available.[3] I believe the key is the individual himself. With what in life will one be best satisfied? The answer is to be found in an analysis by oneself of his real desires—the underlying drive that subconsciously directs his professional effort. Which pattern affords the best chance of satisfying them?

Take every opportunity, such as engineering-society meetings, to learn by conversations with those living within the different patterns, the sources of satisfaction obtainable in each type and the methods used to achieve it. Read philosophical and historical masterpieces and apply their teaching to help build up the mental and spiritual strength necessary to make that most important choice—the lifetime pattern of living.

Whatever may be the ultimate aim of the individual machine designer, he should start out by working for the large corporation, to perfect his art, and to learn more quickly the extent of the field and the trends of industry. It is also an excellent place to test the psychological analysis just mentioned. There he can select his final objective, within or outside of the organization, and await his opportunity to grasp it.

We must come to the conclusion that there is a really large field of professional endeavor, bridging engineering work as it is generally practiced and true invention. This may be aptly called creative engineering. But creative engineering also includes many other activities, and can be found, among other places, in editorial work, in teaching, and in the development of new and useful mental tools for the engineer. Machine design and its ancillary arts are today the principal expressions of creative mechanical engineering. There is even a chance that the term engineering design, including the design of structures, bridges, ships, canals, and so on, as well as that of machines may by common usage become synonymous with the term creative engineering.

Today's Challenge

While progress toward elimination of human slavery has been marked with success in the Western World, elsewhere a fearsome challenge has arisen. Out of the middle ages has suddenly erupted a vast horde of barbarians intent on seizing our machines designed to eliminate slavery, for the purpose of turning them against us for our re-enslavement.

In manpower our present enemies so outnumber us that our only salvation lies in the development of still better machines for both civilian and military use, to protect and to defend us. Into the competent hand of the free creative engineer I deliver this gauntlet, confident of his skill. Consequently, I am unafraid of the future.

[3] "Management of the Small Manufacturing Plant: Its Characteristics and Advantages," by Crosby Field, MECHANICAL ENGINEERING, vol. 52, 1930, pp. 901–904.
"The Small Manufacturing Company as an Opportunity for Engineering Graduates," by Crosby Field, MECHANICAL ENGINEERING, vol. 71, 1949, pp. 316–320.

Weather Aging of
Styrene and Phenolic Plastics

Test data developed to help the designer select plastics to meet wide range of climatic conditions

By J. R. Taylor[1] and C. H. Adams[2]

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THE use of plastic materials in applications where good outside weathering characteristics are required is increasing. The aircraft, automotive, communication, construction, and associated industries are only a few of those using plastics for outdoor applications in ever-increasing amounts. Examples of such uses are television-antenna insulators, foam-styrene lenses in microwave relay towers, reinforced plastic automobile bodies, and air-conditioner housings. Plastic materials in these and other outdoor applications must give dependable service in a wide range of environments.

To aid the design engineer in the proper choice of plastic materials, data on the physical properties of the material, exposed outdoors for long periods of time, must be available. The weathering program presented in this paper was undertaken to make available data on the physical properties of styrene and phenolic materials exposed outdoors at three locations for intervals up to and including four years.

Experimental

The exposure sites were chosen so that warm dry, warm moist, and cyclical climates would be included. The three locations selected to cover the wide range of climatic conditions were (1) Ft. Lauderdale, Fla., (2) Phoenix, Ariz., and (3) Springfield, Mass. Ft. Lauderdale was chosen because of its high temperatures, moderate to high rainfall, and high humidity; Phoenix, for its high temperatures, low rainfall, and low humidity; Springfield for its extremes in summer and winter.

Weather Data

All weather data for each exposure site were obtained from the nearest U. S. Weather Bureau Station. The data plotted for Ft. Lauderdale were recorded at Miami, a distance of approximately 40 miles from the exposure location. It was felt that since Miami and Ft. Lauderdale are comparatively close together, the terrain between the two flat, and both located on the East Florida Coast, the average weather data would be the same for the two locations.

Data plotted for Springfield were taken at Brainard Field, Hartford, Conn., a distance again of about 40 miles from the specimen racks. Here the recording station and the exposure racks were in the Connecticut River Valley and close enough together that the average weather data were the same for both. The data plotted for Phoenix were obtained from the Weather Bureau Station in Phoenix.

The exposed specimens were tested, where possible, in accordance with standard ASTM procedure. The tests used to show the effect of exposure on the mechanical properties were tensile strength and elongation (ASTM D638-49T for styrene; ASTM D651-48 for phenolic), flexural strength and defection (ASTM D790-45T), and impact strength (ASTM 256-47T). Loss of weight as a result of outdoor exposure was followed by percentage weight change. Changes in heat resistance of the weathered samples were shown by heat distortion (ASTM D648-45T). The effect of outdoor exposure on the electrical properties was followed by the change in dielectric constant and dissipation factor (ASTM D150-47T) and dielectric-strength properties (ASTM D149-44).

The ASTM test method for dielectric-strength measurements was not followed for styrene. The method adopted follows: The voltage across the test specimen was raised at a rate of 1000 volts per sec to 50,000 volts and left at this stress for 600 sec. The value recorded for breakdown was the time in seconds, if less than 600, to fail at 50,000 volts. This method was used because the maximum available voltage in the laboratory was 50,000. Dimensional stability was determined by the change of a length measured before exposure. Water absorption was determined by ASTM D570-42.

Specimens

The specimens exposed were molded from crystal styrene, gray pigmented styrene, and a black pigmented wood flour-filled general-purpose phenolic. The two styrene materials were exposed to determine the effect of pigment on the weathering resistance of styrene. The wood flour-filled phenolic was chosen since it is the most widely used material in this generic family. The styrene specimens were injection-molded on an 8-oz Reed-Prentice injection-molding machine using a six-cavity physical testing die. The molding conditions were cycle 45/45 sec, temperature 400/400 F, ram

[1] Physicist, Research Department.
[2] Group Leader, Research Department.

Contributed by the Rubber and Plastics Division and presented at the Semi-Annual Meeting, Pittsburgh, Pa., June 20-24, 1954, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

pressure 800 psi, nozzle temperature high, and booster $2^1/_2$ sec. The die was kept at 70 C. The phenolic molding compound was preheated for 6 min at 85 C and compression-molded with a hand mold. The molding conditions were temperature 340 F, cure time 6 min, and pressure 3600 psi.

Panels

Three panels of samples were assembled for an exposure period. One panel was sent to each weathering location for every period. There were 7 exposure periods so that in all 21 panels were assembled. Standard ASTM specimens were used throughout. The test specimens comprising a set for one panel are listed in Table 1.

Table 1 Test Specimens

Styrene (crystal and pigmented)
- 10 tensile specimens of each (tensile properties)
- 10—5 × $^1/_2$ × $^1/_8$-in. bars of each (*a*) heat distortion; (*b*) impact strength
- 3—5 × $^1/_2$ × $^1/_4$-in. bars of each (flexural properties)
- 3—4 × $^1/_8$-in. disks of each (*a*) dimensional change; (*b*) electrical properties
- 3—2 × $^1/_8$-in. disks of each (*a*) weight change; (*b*) water absorption

Phenolic
- 5 tensile specimens—dogbone (tensile properties)
- 10—5 × $^1/_2$ × $^1/_8$-in. bars (*a*) dimensional change; (*b*) flexural properties; (*c*) impact strength
- 3—4 × $^1/_8$-in. disks (dielectric strength)
- 3—2 × $^1/_8$-in. disks (*a*) weight change; (*b*) water absorption

Exposure

The exposure plan was so designed that during the early stages of weathering, tests were made more frequently. This plan was adopted so that the initial changes could be followed closely. Tests on the exposed samples were made at the following intervals: 3, 6, 12, 18, 24, 36, and 48 months. The assembled exposure panels were attached rigidly to racks, Fig. 1, inclined at 45 deg facing south at each location. Control-specimen sets identical in number to those exposed outdoors were kept in the dark in a laboratory having a standard atmosphere (23 C 50 per cent RH). These were tested in parallel with weathered sets.

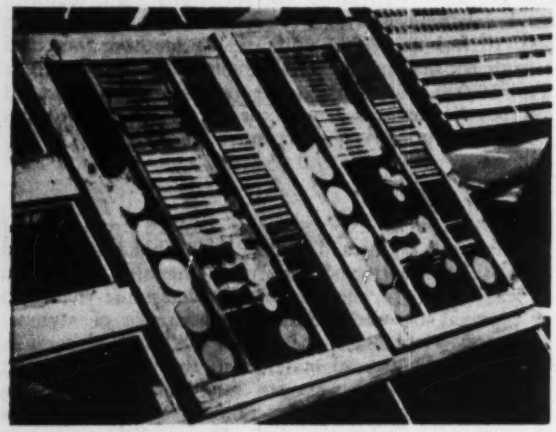

Fig. 1 Exposure rack at Springfield, Mass. Panels were inclined at 45-deg angle, facing south.

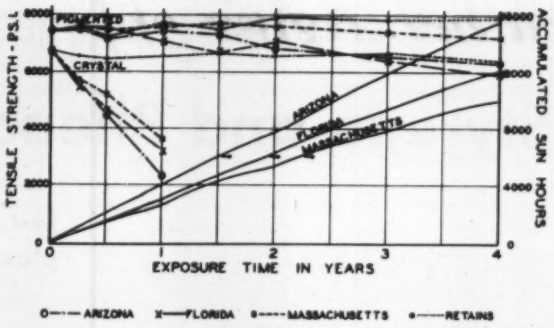

Fig. 2 Tensile strength of styrene plastic and accumulated sun hours versus exposure time

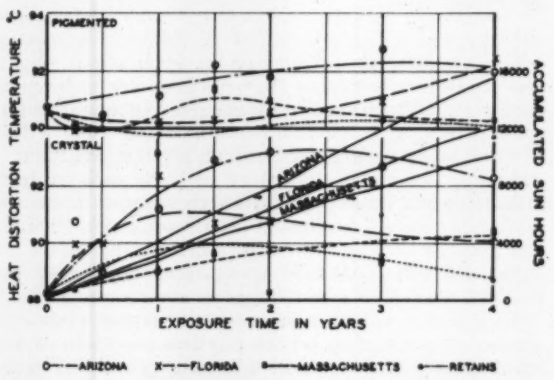

Fig. 3 Heat-distortion temperature of styrene plastic and accumulated sun hours versus exposure time

Conditioning Samples

All specimens were conditioned according to ASTM D618-47T prior to testing. The disks, 2 in. diam, used to determine weight change, were not conditioned until after they had been weighed following aging. This was done to prevent weight change being affected by factors other than outside weather. Any specimen with surface dust was wiped off with a dry cloth before being tested.

The complete compilation of test data is presented in Tables 2, 3, and 4.

Styrene Test Results

Three months' exposure at each location caused serious degradation of the crystal styrene. This was evidenced by pronounced yellowing and crazing. The Arizona location was by far the most severe based on visual examination of the samples. Tensile specimens exposed at all locations were too brittle to test after 12 months' exposure, Fig. 2. The loss of strength both tensile and flexural with aging is directly related to the amount of sunshine (ultraviolet radiation) falling on the material. Pigmentation of the crystal styrene to an opaque gray gave a weather-resistant material showing little change in strength with 4 years' exposure. The action

Table 2 Weathering of Crystal Styrene Plastic

		Exposure time in months							
		0	3	6	12	18	24	36	48
Tensile strength (psi)	Arizona	6700	5600	4500	2300	—	—	—	—
	Florida	6700	5400	4700	3200	—	—	—	—
	Massachusetts	6700	5700	5200	3600	—	—	—	—
	Retain	6700	6600	6500	6600	6700	6600	6700	6400
Tensile elongation (%)	Arizona	1.55	1.20	1.00	0.50	—	—	—	—
	Florida	1.55	1.17	1.07	0.70	—	—	—	—
	Massachusetts	1.55	1.25	1.17	0.75	—	—	—	—
	Retain	1.55	1.55	1.45	1.5	1.47	1.52	1.45	1.35
Flexural strength (psi)	Arizona	11300	5700	5300	5400	3400	3200	1950	1600
	Florida	11300	7800	4800	3850	3850	3300	2200	1700
	Massachusetts	11300	9000	7500	5400	4800	4400	4000	1500
	Retain	11300	11100	10900	11700	11300	11250	9700	10600
Flexural deflection (in.)	Arizona	0.24	0.11	0.11	0.11	0.08	0.08	0.05	0.04
	Florida	0.24	0.15	0.10	0.09	0.09	0.09	0.06	0.05
	Massachusetts	0.24	0.16	0.15	0.11	0.11	0.11	0.09	0.07
	Retain	0.24	0.24	0.23	0.26	0.25	0.25	0.22	0.23
Izod impact (ft-lb/in.)	Arizona	0.28	0.21	0.19	0.24	0.32	0.22	0.21	0.22
	Florida	0.28	0.18	0.22	0.26	0.27	0.22	0.22	0.22
	Massachusetts	0.28	0.19	0.25	0.32	0.34	0.25	0.30	0.24
	Retain	0.28	0.20	0.20	0.32	0.38	0.28	0.34	0.33
Heat-distortion temp (°C)	Arizona	88.3	90.8	89.0	91.2	92.9	93.2	92.7	92.3
	Florida	88.3	90.0	90.0	92.5	90.7	90.8	89.5	90.3
	Massachusetts	88.3	88.4	—	89.0	89.6	88.3	89.3	90.5
	Retain	88.3	89.5	—	89.1	89.8	89.7	91.0	88.7
Water absorption (%)	Arizona	0.050	0.069	0.053	0.060	0.022	0.057	0.056	0.004
	Florida	0.050	0.070	0.057	0.040	0.040	0.047	0.057	0.041
	Massachusetts	0.050	—	0.053	0.065	0.080	0.073	0.064	0.043
	Retain	0.050	—	0.047	0.053	0.050	0.037	0.037	0.06
Weight change (%)	Arizona	0.00	+0.20	+0.15	+0.10	−0.23	−0.55	−1.12	−1.75
	Florida	0.00	+0.15	+0.10	+0.15	−0.55	−0.90	−1.80	−2.57
	Massachusetts	0.00	—	+0.15	+0.15	−0.05	−0.20	−0.60	−1.05
	Retain	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dissipation factor @ 1 kc	Arizona	0.00015	0.00037	0.00030	0.00032	0.00046	0.00041	0.00049	0.00100
	Florida	0.00015	0.00019	0.00040	0.00036	0.00052	0.00054	0.00056	0.00125
	Massachusetts	0.00015	0.00026	0.00028	0.00038	0.00039	0.00044	0.00054	0.00102
	Retain	0.00015	—	0.00012	0.00012	0.00010	0.00018	0.00024	0.00012

Table 3 Weathering of Gray-Pigmented Styrene Plastic

		Exposure time in months							
		0	3	6	12	18	24	36	48
Tensile strength (psi)	Arizona	7500	7500	7200	7400	7300	6800	6600	6300
	Florida	7500	7500	7600	7100	6700	7100	6400	5900
	Massachusetts	7500	7600	7500	7600	7700	7600	7400	7200
	Retain	7500	7600	7300	7800	7500	7900	7800	7900
Tensile elongation (%)	Arizona	2.15	1.90	1.75	1.90	1.85	1.60	1.47	1.30
	Florida	2.15	1.82	1.95	1.75	1.60	1.60	1.40	1.20
	Massachusetts	2.15	2.02	2.10	2.10	1.90	2.00	1.70	1.55
	Retain	2.15	2.10	1.97	2.17	2.12	2.15	2.12	2.12
Flexural strength (psi)	Arizona	11900	10200	9900	9800	9900	8700	7700	8400
	Florida	11900	9700	10300	9400	9200	8700	6100	7300
	Massachusetts	11900	9900	11300	10000	8200	9200	9500	7000
	Retain	11900	—	12900	13400	13600	13200	13300	13300
Flexural deflection (in.)	Arizona	0.24	0.20	0.21	0.22	0.20	0.19	0.16	0.18
	Florida	0.24	0.19	0.22	0.20	0.19	0.18	0.12	0.16
	Massachusetts	0.24	0.20	0.24	0.21	0.17	0.20	0.20	0.14
	Retain	0.24	—	0.33	0.36	0.38	0.34	0.35	0.32
Izod impact (ft-lb/in.)	Arizona	0.19	0.19	0.20	0.25	0.39	0.25	0.26	0.23
	Florida	0.19	0.19	0.19	0.36	0.38	0.28	0.27	0.25
	Massachusetts	0.19	0.20	0.22	0.37	0.36	0.28	0.28	0.22
	Retain	0.19	—	0.17	0.33	0.36	0.22	0.26	0.28
Heat-distortion temp (°C)	Arizona	90.8	90.1	90.5	91.2	92.2	91.8	92.8	92.0
	Florida	90.8	89.9	90.4	90.2	90.3	90.6	91.0	92.5
	Massachusetts	90.8	89.8	90.3	89.1	91.4	91.0	90.3	90.3
	Retain	90.8	90.1	90.0	89.8	91.3	90.5	90.3	89.7
Dissipation factor @ 1 kc	Arizona	0.00077	0.00064	0.00032	0.00044	0.00038	0.00075	0.00040	0.00082
	Florida	0.00077	0.00064	0.00038	0.00054	0.00070	0.00090	0.00088	0.00160
	Massachusetts	0.00077	0.00075	0.00034	0.00059	0.00056	0.00056	0.00056	0.00098
	Retain	0.00077	0.00076	0.00046	0.00054	0.00049	0.00067	0.00059	0.00072

Table 4 Weathering of Wood Flour-Filled Phenolic (Black Pigment)

		Exposure time in months							
		0	3	6	12	18	24	36	48
Tensile strength (psi)	Arizona	5900	5600	5800	5900	7100	5600	5400	4700
	Florida	5900	4750	4650	4800	4850	4300	3750	3700
	Massachusetts	5900	5500	5000	5070	5350	5500	4600	4600
	Retain	5900	—	6250	7500	6200	6000	6600	5700
Flexural strength (psi)	Arizona	8900	9000	9100	9350	9650	10000	9500	8350
	Florida	8900	6950	6800	7950	7400	7700	6400	6550
	Massachusetts	8900	7750	7800	8500	7950	9050	8100	7250
	Retain	8900	—	9300	11450	9400	9950	9400	9000
Flexural deflection (in.)	Arizona	0.042	0.042	0.041	0.042	0.041	0.045	0.043	0.036
	Florida	0.042	0.032	0.032	0.039	0.038	0.037	0.031	0.029
	Massachusetts	0.042	0.035	0.036	0.038	0.038	0.044	0.040	0.033
	Retain	0.042	—	0.045	0.056	0.043	0.048	0.043	0.041
Izod impact (ft-lb/in.)	Arizona	0.32	0.34	0.32	0.33	0.38	0.32	0.41	0.45
	Florida	0.32	0.31	0.28	0.28	0.32	0.27	0.29	0.29
	Massachusetts	0.32	0.32	0.32	0.32	0.37	0.30	0.32	0.28
	Retain	0.32	—	0.32	0.31	0.35	0.30	0.33	0.36
Weight change (%)	Arizona	0.00	−0.22	−0.64	+0.80	−1.32	−1.10	−1.77	−1.90
	Florida	0.00	+1.20	+0.96	+0.76	0.00	−0.15	−0.83	−1.62
	Massachusetts	0.00	—	+0.60	+0.72	0.00	+0.50	+0.15	−0.54
	Retain	0.00	—	+0.40	+0.32	+0.40	+0.64	+0.65	+0.75
Water absorption (%)	Arizona	5.4	5.4	7.0	5.3	5.6	6.9	6.4	6.3
	Florida	5.4	7.0	7.5	6.5	8.2	8.3	9.3	7.9
	Massachusetts	5.4	—	6.2	6.8	7.9	7.4	7.8	6.9
	Retain	5.4	—	6.9	4.8	6.0	5.4	5.5	4.4
Dielectric strength (volts/mil) (short time)	Arizona	400	405	—	385	380	380	355	385
	Florida	400	360	—	290	235	225	235	280
	Massachusetts	400	375	—	300	290	270	255	320
	Retain	400	385	—	350	335	285	300	360
Dielectric strength (volts/mil) (step by step)	Arizona	290	270	—	275	285	300	300	305
	Florida	290	245	—	200	175	205	200	160
	Massachusetts	290	260	—	200	220	240	225	192
	Retain	290	280	—	245	235	225	245	255

of the pigment is thought to be a combination of reflection, scattering, and absorption with reflection controlling.

Heat Distortion

The heat-distortion temperature showed a tendency to increase with exposure time at all locations. This is shown in Fig. 3. It appears to be due to the annealing action of the sun's radiation. The fact that Arizona exposure causes the greatest increase seems to verify this observation. It is verified further by the higher rate of increase for the crystal compared with the pigmented styrene. The more complete annealing of the crystal styrene is related to its greater transparency to infrared radiation.

Erosion and Evaporation

Erosion and evaporation of residual monomer are felt to be the prime causes for loss in weight of exposed samples. Florida exposure caused the greatest change with moderate erosion (owing to heavy rainfall) and monomer evaporation (because of infrared heating) accounting for the loss. Arizona specimens showed the next highest loss. Here the predominating effect was felt to be monomer evaporation. Springfield weather was the least severe. Percentage weight change versus exposure time and location is shown in Fig. 4.

Dielectric Properties

Dielectric properties, viz., dielectric constant, dissipation factor, and dielectric strength, of both crystal and pigmented styrene deteriorated with outdoor exposure. There was a wide spread in the dielectric-strength results. The reasons for the variability are unknown. As was the case with other properties, crystal styrene was degraded appreciably more than the pigmented. The Florida location with its high rainfall, relative humidity, and temperature was the worst. This is thought to be related to moisture absorption in voids created by surface erosion.

Impact Strength

Impact strength showed no trend with either the material or location factors. This is due in part to the fact that the specimens were notched after exposure; i.e., the weathered skin was cut away during notching.

No trend was established for water-absorption behavior.

The control specimens retained in the dark in a stand-

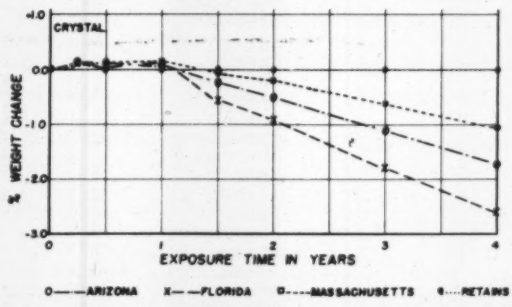

Fig. 4 Weight change of styrene plastic versus exposure time

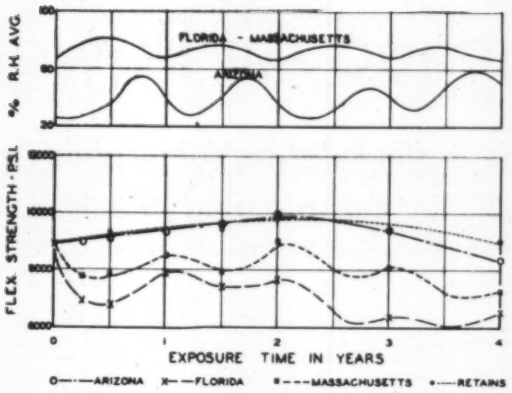

Fig. 5 Flexural strength of phenolic plastic and relative humidity versus exposure time

ard ASTM atmosphere (23 C, 50 per cent RH) showed no significant change in level of any physical property during the four years the program was in progress.

Results of Tests on Phenolic

Gain or loss of moisture and chemical degradation are probably the two most important mechanisms responsible for the observed mechanical behavior of phenolic exposed to the outdoors. Moisture has a plasticizing effect on the plastic. During the molding or curing operation, water is released by the condensation reaction. A portion of this water is trapped in the material. During outside exposure, the initial level will vary depending on the average temperature of the specimen and the average relative humidity of the surrounding atmosphere. A gain in moisture will lower strength and increase ductility. A decrease in moisture will have the opposite effect. The high relative humidities in Massachusetts and Florida account for a substantial part of the observed loss in strength.

Fig. 5 indicates a seasonal trend in strength related to the humidity level. The over-all downward trend of the strength properties at all locations is indicative of chemical degradation due in part to ultraviolet radiation.

Weight Change

Weight change of phenolic is related to residual volatiles (primarily water), possible continued cure, and erosion. Evaporation and erosion are thought to be the dominant factors. Specimens weathered in Arizona, where the relative humidity and rainfall were low lost weight mainly by evaporation. The losses in Massachusetts and Florida are postulated to be due primarily to erosion. The increase in weight of the retained samples was simply due to moisture pickup.

Water Absorption

Water absorption appeared to be a function of the surface condition of the sample. Thus, where erosion took place to an appreciable extent, the water absorption was high. Florida exposed specimens showed the greatest water absorption with Massachusetts next and Arizona last.

Dielectric-strength data showed Florida weather to be the most damaging, with Massachusetts next in severity. Specimens exposed in Arizona evidenced little to no change in this property. An increase in moisture content of a phenolic molding compound of this type generally lowers the dielectric strength. From the foregoing argument it may be assumed that specimens aged outside in Florida and Massachusetts had picked up significant amounts of moisture and that those aged in Arizona had gained very little. The retains were consistent with this predicted relationship.

Conclusions

The weather elements contributing most to the degradation of the exposed specimens appeared to be (1) ultraviolet radiation, (2) humidity, (3) rain and dust erosion, and (4) temperature. In general, Florida weather was the most damaging to the pnysical properties of both styrenes and the phenolic material.

Styrene

- **The mechanical and electrical properties of unpigmented styrene were degraded seriously by exposure to outdoor weather for a period as short as 3 months.**
- **The degree of degradation was closely associated with the amount of sunlight reaching specimen.**
- **The weather resistance was improved significantly by the addition of a pigment to the styrene.**
- **The surface of both styrenes was roughened after 4 years' exposure by erosion. Although the strength properties of the pigmented styrene showed little change, the surface had yellowed.**

Phenolic

- **The phenolic compound, a black pigmented wood flour-filled material, was degraded mechanically and electrically by semitropical weather (high humidity, high temperatures, and moderate rainfall).**
- **Specimens aged in a hot dry climate showed no appreciable shift in strength and electrical properties during the exposure period.**
- **The loss of weight of the exposed samples may be attributed largely to both evaporation and erosion.**
- **The change in appearance due to outdoor exposure was caused by surface erosion.**

Modern Sea-Launched Air Power

A Study in the Relative Vulnerability of the U.S.S.R., Europe, and the U. S. A.

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THOUGH much verbal discussion has taken place and numerous classified reports have been presented, little, if any, specific information has been released concerning the relative vulnerability of the U.S.S.R., Europe, and the United States to modern sea-launched air power. It has been commonly accepted that probable (in the case of war) European objectives are much more accessible to a sea-launched air force than, for example, the Soviet objectives—but the precise degree of accessibility and the possible quantitative results from a given type of air unit (e.g., ballistic rocket) have received no public discussion. In the light of the present policies, it seems that some analysis of the situation should be presented to provide the aircraft researcher and manufacturer with some background material concerning the possible present and future military planning.[1]

This paper considers both the distribution of probable Soviet, European, and American strategic objectives, based upon demographic studies, and a discussion concerning the manner in which these studies may be applied to submarine-launched air weapons such as an A-4 (V-2) type, single-stage, ballistic rocket.

Strategic Objectives

In order to assess the striking power of any type of sea-launched air unit as a function of range, it is first necessary to evaluate the importance and number of strategic objectives (or probable targets) as a function of the distance from the seacoast. Included under the heading of "strategic objectives" are the following: (1) industrial targets; (2) nerve centers (e.g., transportation and communication centers); (3) population centers; (4) research and development centers; (5) military installations.

In the absence of classified security information, the assumption has been made that the importance and number of strategic objectives, as outlined, in a given area would be roughly proportional to the urban population in that area. Little justification for this assumption will be presented. A comparative analysis of each of the objectives listed, with the possible exception of military installations, will reveal a close proportional correlation to the urban population for both Europe and the United States. It is the opinion of the author that although the foregoing assumption appears valid for the continent of Europe and the United States, the relative validity is questionable when applied to the Soviet Union.[2] There is no doubt, however, that even in the U.S.S.R., a rough approximation of the industrial objectives could be achieved through a demographic study.

Demographic/Geographic Studies

Demographic and geographic studies have been carried out for all of the larger cities of the Union of Soviet Socialist Republics, Europe, and the United States of America. In general, the population data were obtained for all cities[3] with populations exceeding 40,000 to 50,000 inhabitants. Each of these cities was located and the air distance from the city to the nearest unblockable coastal area[4] was measured. Then, the "Cumulative Population for Cities Whose Population Exceeds 40,000/50,000 Persons" was plotted as a function of the "Distance From the Unblockable Coastal Area" for the Union of Soviet Socialist Republics, Europe, and the United States of America. This plot, entitled "Comparative Location of Major Urban Population for the U. S. A., Europe, and the U.S.S.R.," is shown in Fig. 1. The importance of the results presented in Fig. 1 cannot be overemphasized. From this figure, assuming other conditions[5] constant (or having some knowledge concerning the associated conditions[5]), the relative (against one area as compared to another) effectiveness of a given sea-launched air unit may be approximated.

For example, such data as that shown in Table 1 would be useful in considering the possible effectiveness

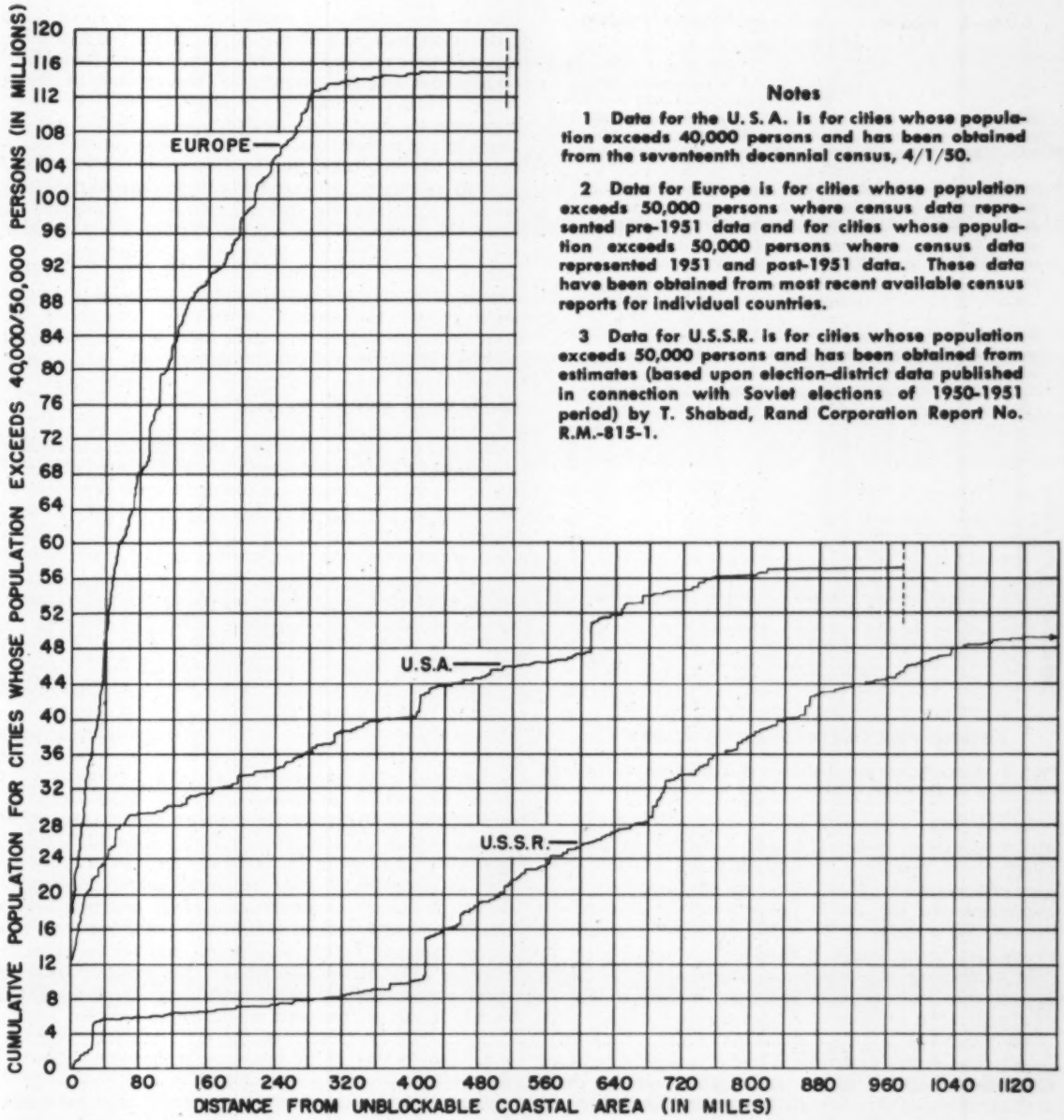
[1] As explained, numerous classified reports have been prepared. However, it is extremely difficult and in many cases it is impossible for the aircraft manufacturer to obtain such reports which are concerned with over-all planning.

[2] The validity of this assumption is questionable when applied to the Soviet Union owing to the dictatorial means of industrial expansion and relocation that has been taking place in the U.S.S.R. However, there are a minimum number of persons that are necessary for any reasonable industrial area.

[3] The broad definition of a "city" is assumed to be an urban grouping of persons. The precise definitions that were utilized in this study were those utilized in the respective census reports for the various countries; these definitions may differ slightly from country to country.

[4] The "unblockable coastal area" is defined to be any seacoast or shore that could remain approachable to seagoing craft during hostile conditions. The assumption was made that seagoing craft would be capable of entering any bay, gulf, harbor, or inlet whose entrance is greater than ten miles in width. It also was assumed that seagoing craft would be capable of entering the Baltic and Mediterranean Seas; it was conversely assumed that the Black and Caspian Seas would be inaccessible to such craft.

[5] "Conditions" being exemplified by affecting factors such as climatic and geographic conditions, warning-defense systems, combat defenses, etc.



Notes

1 Data for the U. S. A. is for cities whose population exceeds 40,000 persons and has been obtained from the seventeenth decennial census, 4/1/50.

2 Data for Europe is for cities whose population exceeds 50,000 persons where census data represented pre-1951 data and for cities whose population exceeds 50,000 persons where census data represented 1951 and post-1951 data. These data have been obtained from most recent available census reports for individual countries.

3 Data for U.S.S.R. is for cities whose population exceeds 50,000 persons and has been obtained from estimates (based upon election-district data published in connection with Soviet elections of 1950-1951 period) by T. Shabad, Rand Corporation Report No. R.M.-815-1.

Fig. 1 Comparative location of major urban population for the U. S. A., Europe, and the U. S. S. R.

of a submarine-launched ballistic-rocket-type missile; such data in combination with the technical data would aid one not only in determining the military effectiveness of already existing missiles but in the future design of a militarily effective weapon from the optimum economic considerations.

Design of a Militarily Effective Weapon

To understand more fully this latter statement, let us consider a specific type of missile—a submarine-launched, single-stage, ballistic rocket—which is to be designed as a weapon to be used against an area which has a "cumulative population versus distance" curve such as that shown by the solid line in Fig. 2. Assume, from the technical and economic considerations of a single-stage ballistic rocket, that the cost of such a weapon (as a function of range) is portrayed by the dashed curve in the same figure.[6]

This curve, perhaps, deserves some discussion. As the range of the missile increases, the missile becomes larger as more fuel is required; thus the cost per unit increases. The same guidance system may be adequate

[6] It is assumed that the guidance system is so designed that, roughly, the same probability of a hit exists at the longer ranges as exists at the shorter ranges.

Table 1 Missile Range Versus Relative Possible Effectiveness

Missile range, miles	Objective area	Per cent of total urban population within missile range (assuming missile to be launched from nearest unblockable coastal area)
60	U.S.S.R.	11.8
	Europe[a]	52.8
	U. S. A.	49.2
150	U.S.S.R.	13.4
	Europe[a]	77.9
	U. S. A.	55.4
400	U.S.S.R.	20.3
	Europe[a]	99.5
	U. S. A.	70.6

[a] Europe, excluding the U.S.S.R., and including Turkey.

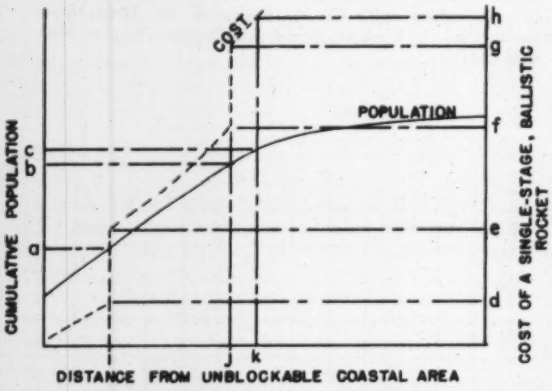


Fig. 2 Cumulative population-versus-distance curve, and cost of a single-stage ballistic rocket as a function of range

up to a certain range (i^-); for a further increase in range it is necessary to introduce an entirely new guidance system.[6] This change in guidance systems is responsible for the abrupt jump in missile cost, $\Delta(e\text{-}d)$ dollars, for a range of i^+ miles. A similar condition exists at a higher range, j miles.

In examining the population curve alone, it might appear that the optimum economic missile should be designed to be capable of ranges up to k miles. This is owing to the fact that the slope of the "cumulative population versus distance" curve is roughly constant for distances up to k miles; at k miles, there is a sharp decrease in slope, this decrease being maintained throughout the range under possible consideration.

When considering the "cost versus range" curve, as well as the population curve, it can be seen that a more likely optimum economic missile might be designed for ranges up to j miles. For the small loss in range, $\Delta(k\text{-}j)$ miles, there is a corresponding small loss in target capacity, $\Delta(c\text{-}b)$ persons, and the missile cost has been considerably reduced by $\Delta(b\text{-}f)$ dollars; thus the "average cost per probable kill" is much less for a missile designed for a range of j miles than for one designed for a range of k miles. However, depending upon the slope of the population curve before and after point k, this point (k) may signify the upper limit of the desirable design ranges.

The conditions and facts concerning the problem have, of course, been greatly oversimplified. The assumption that a fixed amount of capital is available for missile production has been implied. Similarly, it has been assumed that the size and importance of the individual targets have an equal distribution throughout the entire range. No account of other weapons to satisfy the same requirements has been considered. Similarly, no account of the various types and distribution of the area's defenses has been taken into consideration. All of these, as well as others, are extremely important factors that would enter into the over-all decision. However, it is not the purpose of this paper to examine any particular weapon to serve a precise purpose in a definite area. The purpose is to present some definite data (Fig. 1) to provide the aircraft manufacturer and his technical personnel with greater background information concerning the relative vulnerability of certain areas and to bring out some of the limitations that presently exist.

Single-Stage Ballistic Rockets

In 1946 W. G. A. Perring,[7] Deputy Director of Research and Experiments at the Royal Aircraft Establishment, presented a paper containing a critical review of the German long-range rocket developments.[8] In this paper, Mr. Perring not only discussed what had already been accomplished by the Germans during World War II but also discussed and presented some of the practical limitations that he thought would exist in the future. On the assumption that atomic rocket power plants are still some years in the future, many of the limitations that Mr. Perring advanced in 1946 remain valid today.

Intensive work on the A-4 (V-2),[9] a single-stage ballistic rocket, started in 1940, and it went into production at the end of 1942. It was first utilized in attacks against England in September, 1944. The total loaded weight of the A-4 was about 12.5 tons (slightly over 28,000 lb), which included a little over 19,300 lb of fuel and a 2150-lb warhead; the actual range of this rocket varied widely (the maximum being about 220 miles) but averaged between 180 and 190 miles.

In his paper Mr. Perring demonstrated, for this type of rocket, the effect on aerodynamic range resulting from a change in total rocket weight (W), the ratio of fuel weight to total rocket weight (α), and the fuel specific impulse (S). He showed that a percentage change in total rocket weight has a secondary effect upon the rocket range as compared to the effect reflected by the same percentage change in the ratio of fuel weight to total rocket weight or fuel specific impulse; this can be seen readily in Figs. 3 and 4.

If the warhead in the A-4 were replaced by an equivalent weight of fuel, the ratio of fuel weight to total rocket weight (α) would approach its practical limit; this would correspond to an α of about 0.76. Though the most practical value of fuel specific impulse (S), assuming reasonable combustion temperatures, lies between 180 and 240 sec, it is conceivable that a fuel specific impulse approaching 300 sec could be obtained (see Table 2). In lieu of these considerations, as can be seen from Figs. 3 and 4, the upper limit to the maxi-

[7] Now deceased.

[8] "A Critical Review of German Long-Range Rocket Development," by W. G. A. Perring, *Journal of the Royal Aeronautical Society*, July, 1946.

[9] The A-4 was, essentially, a scaled-up version of the A-3, which had been designed in 1938 and which had resulted from five years' work on the A-1 and A-2. The A-3 weighed approximately 1650 lb and had a maximum range of about 11 miles.

Table 2 Combustion Temperatures and Fuel Specific Impulse for Four Rocket Fuel-Oxidant Combinations

Fuel-oxidant combination	Combustion temperature, deg K	Fuel specific impulse, sec
Hydrazine hydrate-hydrogen peroxide	1750	200
Petrol-oxygen	2240	224
Ethyl alcohol-oxygen	2780	235
Hydrogen-oxygen	2560	343

Note: Taken from "A Critical Review of German Long-Range Rocket Development," by W. G. A. Perring, *Journal of the Royal Aeronautical Society*, July, 1946.

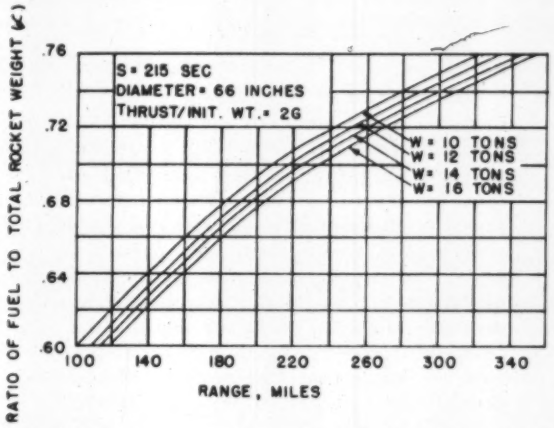


Fig. 3 Effect of α on range for an A-4 (V-2) type ballistic rocket (see footnote 8)

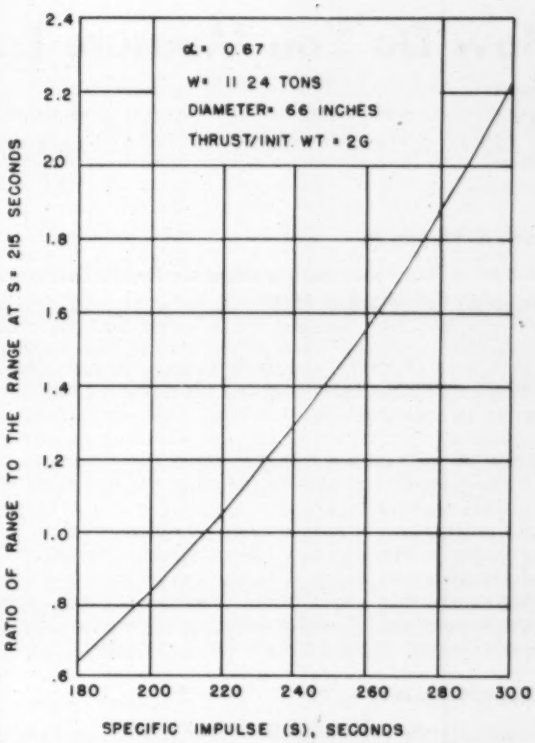


Fig. 4 Effect of fuel specific impulse on range for an A-4 (V-2) type ballistic rocket (see footnote 8)

mum aerodynamic range that can be achieved from a single-stage ballistic rocket is about (340 × 2.2) or 750 miles. If it is assumed that a practical ratio of fuel weight to total rocket weight is about 0.72 (some weight being available for an atomic warhead) and that a fuel specific impulse of 260 sec is available, the present maximum aerodynamic range of such a rocket would be in the neighborhood of (260 × 1.55) or 400 miles.

Thus, assuming such weapons can be designed successfully (including a guidance system) to be launched from submarines, it can be seen immediately, from Fig. 1, Fig. 5, or Table 1, that both Europe and the United States are far more vulnerable to them than is the Soviet Union. Percentagewise, the United States is over four times as vulnerable (assuming similar defense systems) to such weapons as is the U.S.S.R. (see Fig. 5). Europe is even more vulnerable than the United States.

The fact that the Soviets not only have continued but have expanded both the German operations at Peenemunde and their submarine production seems to imply that they are well aware of their advantage in the ballistic-rockets field. Conversely, it seems that the American offensive strategic weapons should be more highly concentrated in the longer-range guided missiles and piloted bombers. If a war did develop, however, it seems probable that much of Europe would be occupied immediately by Soviet forces; in such a case the ballistic rocket could become an extremely useful American weapon. In any case, it seems that the present primary American and European emphasis—with respect to a ballistic-rocket-type weapon—should be in the development of reasonable defensive measures; this, in itself, is no slight achievement.[10]

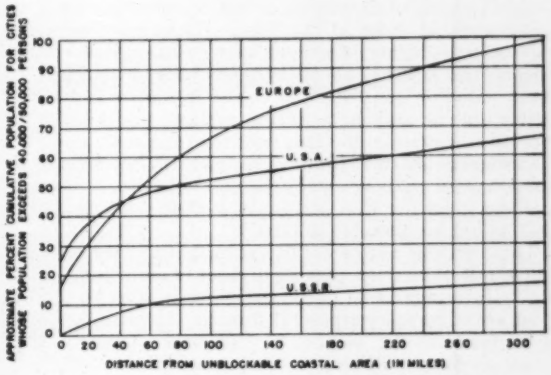


Fig. 5 Approximate per cent cumulative population for cities whose population exceeds 40,000/50,000 persons versus distance from unblockable coastal area

Acknowledgment

A large portion of the basic data was obtained through the financial sponsorship of the Glenn L. Martin Co., Baltimore, Md.

[10] The average speed of the A-4 was about 4000 fps, or 0.75 miles per sec; a 1.0-mile per sec average speed seems reasonable for the present and future single-stage ballistic rockets.

How Do You Measure Engineering Success?

A discussion of the factors by which the individual engineer may determine in terms of service to society and his own satisfaction the degree of his professional attainment

By H. N. Muller, Jr.

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Success in anything, and in engineering in particular, is measured by the individual and his own set of values, not by any standardized definition, code, or yardstick. Engineering success, very likely, is achieving the satisfaction of one's own personal ambitions.

Perhaps we do not like the idea that the ambitions of engineers working in the same company, or at least in the same general area of industry, are all different—in varying degree. But let's face the inevitable. People are individuals; not things. Things can be sorted, sized, categorized—then specifically measured. But this doesn't make the job of answering the question, "How do you measure engineering success?" any easier.

The measure of engineering success is neither a single entity nor any simple combination of factors. It surely is a combining and weighing by each individual of those elements of prestige, financial status, power, contributions to society, and inner contentment which satisfy his particular ego. The degree of attainment of these objectives can be judged only by the individual himself. Judgment must come from the soul—so any thoughtful discussion of measuring engineering success borders more on philosophy than on fact!

What Is Success?

Certainly we can all agree on one thing; that engineering success means widely different things to different people. For example, to one engineer, success may be the attainment of complete happiness and contentment within himself with respect to the technical work he is doing and has done in the past. His engineering contribution to society, however, may be negligible. Conversely, the career of another engineer may be marked by many valuable contributions to the literature and to industry and he may be a well-recognized and highly respected authority. But this same man can be thoroughly discontented within himself because of his failure to reach certain goals he established early in life, or because of some inner fire that continues to burn—an inner urge that he has been unable to satisfy.

These may be extreme illustrations, but in between are thousands of us with varying degrees of ambition. This logically brings us to one question that must be settled if we are to have a purposeful directed discussion. Who is to measure the success of "Engineer Jones?" Our Engineer Jones will be a well-educated, thoroughly motivated, fully professional and ethical individual working in the free-enterprise American capitalistic system of industry. He is typical of the engineer that attends an ASME meeting, intensely interested in his job, ambitious, willing to perform any reasonable amount of work, and cognizant of the fact that his ultimate opportunities are virtually unlimited.

But, who shall measure the success of Engineer Jones? Shall it be other engineers, or some rather fictitious yardstick we might set up, or shall it be one that Engineer Jones would use on himself to shape up his own private measurement of personal success? I suggest the last approach.

Contributed by the ASME National Junior Committee and presented at the Semi-Annual Meeting, Pittsburgh, Pa., June 20–24, 1954.

To acquire the proper perspective, the reader must place himself, for the moment at least, in the position of a senior member of the profession who can look back on his career and his attainments and ask: "What have I done in the 40-odd years of my active career? Have I found my work a challenge? Have I achieved financial security? Have I contributed in a real and enduring fashion to the success, the betterment, the expansion, the prestige, and the recognized position of my organization? What did I basically want from an engineering career, and have I found it?"

It will be noted that these are all questions that only the individual can answer for himself. The opinions of others whose wisdom is respected may be of great assistance to Engineer Jones, but in the last analysis, the answers must come from within. Thus let's evaluate some of the more probable answers, as a guide to young men whose stars are still in the rising phase of their orbits. Only here can our discussion have any lasting constructive influence.

Objectives of a Career

As the senior in our profession looks back, in his attempt at evaluating his individual success, he will consider many facets of his career. These facets will be greatly divergent but all will be important in varying degrees as a function of his individual motivations and balance of values. Let us enumerate and discuss several that I feel have real significance.

Prestige. Nearly all men attach real importance to

the prestige factor. It is a common trait in the nature and behavior of men to desire the approval and acclaim of their associates, their families, and the community. While humility is always a true virtue, and usually is present in liberal measure in really great men, I do not believe that desire for prestige need diminish true humility. It is perfectly proper for engineers who have made their mark through recognized technical or business accomplishment to attach value to the prestige they have earned.

The approval of this prestige factor as a positive measure of engineering success is justified further when we remember some of the deeds by which engineers secure prestige. To mention a few, there are contributions to the technical literature of permanent worth, many of which actually do increase our fund of basic knowledge. There are noteworthy inventions that open horizons for technical contemporaries and sometimes provide the spark that generates new industries. There are engineers who rise to positions of great prestige as professional executives, men who are able to secure for the owners of enterprise, year in and year out, a good return on their investment through consistently earning a good profit margin and a high rate of return on assets.

Financial Status. In twentieth-century America, it is the rare individual whose purse strings do not grow fairly close to his heart. We live in an intensely material community, and we are only closing our eyes to reality if we don't recognize financial achievement as a most positive measure of engineering success. We all work for compensation, and while some engineers attach much more importance to salary than do others, I have never yet met the man who didn't want an increase, and I think practically all men relate pay to success—in some degree at least. This applies to our "longest-haired" research scientist and I think it also applies to our great educators. So let's freely admit that financial success is a definite measure of success in any engineering pursuit.

Power. I bring in this factor now because it relates very closely to both prestige and financial reward. The engineer who has attained a position of power, almost without exception has achieved both prestige and some comparative wealth—even after taxes. The one obvious exception is the government official who may have tremendous power over both individuals and business without great financial status. But I think that in the case of some engineers, both the achievement of prestige and the attainment of high salary brackets were stepping stones on the way to power. The other factors were not goals, but were collateral benefits that came in the side door while on the way to a position of power, this latter being the motivating force.

So, if Engineer Jones wants to evaluate his career success in terms of the power he has accumulated through influential position in industry, through government office, or through educational eminence, he can justifiably do so. Whether we like it or not, power is a very real measure of engineering success.

Contribution to Society. Now we are getting to some of the more philosophical aspects of our discussion and perhaps to the real core of engineering. We are a recognized profession, and to be just that, we must have a high motive of service in all our careers as professional people. To fulfill the obligation of a service motive, we must contribute something real and tangible and lasting to others; to both engineers and the public, in general.

"Contribution to society" is a very general phrase. To be more specific let us substitute an alternative phrase "Advancement of Mankind." Now we have it, as it applies to a successful engineering career. We are talking about those things which improve permanently the living conditions of the general public. We are talking about the engineers who make fast mass transportation a safe, cheap, and convenient fact; engineers who make electric power a reliable, cheap, and accepted part of our life; engineers who guarantee unlimited pure and safe water in our homes; engineers who developed and now provide wire and electromagnetic-wave voice and picture communication. These are factors that have given to us the highest standard of living ever known to man, and for which the engineers are the nerve center.

Even more important, remember that this great factor in evaluating the success of an engineer relates to the public; not to the Engineer Jones and his family! This is really the mission of our engineering profession. This is the motive of true professional men, and we can all be extremely proud of the many engineers in our ranks who obviously must have viewed their ambitions in such lofty terms. Otherwise we could not have achieved the material standards enjoyed by twentieth-century America.

Inner Contentment. This is the item of personal happiness. This is where the engineer has to ask himself whether his career has really given self-satisfaction. Has his attitude toward his company, or toward his profession, been one that made him arise in the morning anxious to tackle the problems of the day with pleasure and enthusiasm? Has he often wished that he had someone else's job, or has his own assignment been the satisfying challenge that leads to daily contentment and permanent enthusiasm?

These are the most important questions of all. Here is the area where Engineer Jones either becomes a motivated professional man—or he becomes a candidate for a change away from engineering, or even an advocate of collectivism. Here also lies one of the greatest responsibilities of management today. For here is where engineers of experience, in management or as technical leaders, can use their experience and wisdom to direct the energies of youth toward success in the engineering profession. And frankly, I am afraid that in this area many leaders in engineering have failed. Witness to this fact is the movement toward unionization of some rather significant blocks of men. Leadership too often has been preoccupied in "putting out fires" and has thus sometimes neglected to give the attention and advice to the young engineer that he needs if maximum professional growth is to follow, and if the attitudes are to develop which will result in "inner contentment" from his career.

It is appropriate for us to recognize the tremendous import of a well-balanced philosophy that permits inner contentment for the successful engineer. We live only once, so we must get the most out of it. This can be achieved only if the individual is intensely interested in his work, for only thus can he be totally satisfied with his career.

Training Engineers

. . . A Mutual Job for Colleges and Industry

By C. H. Shumaker

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Member ASME

With engineers in short supply and an increasing number of problems facing colleges and universities which train them, more emphasis must be placed on the necessity of obtaining assistance from industry which is the beneficiary of this training.

The objectives in training engineers as outlined, indicate an interrelation of university and industry responsibility. Objectives 1 and 2 are strictly the job of the colleges but to satisfy the other two it requires mutual co-operation. As a matter of fact, the rapid advances of technology in the past fifteen years have made necessary more co-operation to satisfy objective (1) as the author shall try to demonstrate.

Great Advances in Technology

It is hardly necessary to recite the advances in technology in the past fifteen to twenty years. They are too well known to engineers to need further comment. However, those of us who were in colleges twenty years or more ago will remember that such words as "electronics" and "soil mechanics" had not even been coined at that time. Now they represent entire new fields of scientific application requiring many complete college courses to acquaint a student with the knowledge developed since their inception. Likewise, twenty years ago in our own field of mechanical engineering, a gas turbine and a rocket motor were only hazy ideas of a possible source of motive power. But today those who would acquire a reasonably complete knowledge of the subjects must take several courses to do so. Where does all this lead with respect to the primary objective of training engineers to practice a profession?

Obviously, the time factor immediately becomes of great importance. Although perhaps no one can state definitely some maximum quantity of instruction that a student is capable of absorbing in four academic years, there certainly must be one and there is ample evidence that such a point has just about been reached in present-day engineering curricula. Roughly the equivalent of a full semester's work has been added to curricula in the past twenty-five years to accommodate new courses which many of the colleges feel should be included. Still other new courses have been added at the sacrifice of service courses and the so-called humanities. We seem to have reached a point of saturation in a four-year standard program unless we are willing to sacrifice existing courses still further. Few, if any, advocate this last procedure.

Contributed by the Oil and Gas Power Division and presented at the Oil and Gas Power Conference, Kansas City, Mo., June 14–17, 1954, of The American Society of Mechanical Engineers.

The primary objectives of engineering education are:

1 To prepare young men (and women, too) to practice a profession which renders a service to mankind through the application of scientific principles.

2 To teach the ethics of a profession and what constitutes professional behavior.

3 To match training with the needs of those organizations which employ engineers.

4 To provide the knowledge necessary to permit the maintenance of a standard of living commensurate with the training and individual ability.

What Can Be Done?

Several suggestions for solving this problem have been made, none of which has received general support as yet. The merits of each could be discussed at considerable length, but they will only be mentioned in this paper:

1 Increase the standard program from four to five years.

2 Continue with a four-year program teaching only the service courses, humanities, basic sciences, and basic engineering sciences, to be followed by a fifth year at the graduate level which will cover the specialties.

3 Select plan number (2) with no follow-up in the specialties, leaving such instruction to the employers of engineers following graduation.

4 Provide two four-year engineering curricula—one scientific (primarily for those interested in research) and one for those who would prepare for technical application in the specialized fields.

Each of these plans (and others not mentioned) are in operation with varying degrees of success but it is obvious that the problem remains unsolved when there is so little agreement among the some 150 engineering colleges in this country. So, something should be done to assist them in making a decision. It is at this point that industry should make its opinions known,

as most engineering graduates end up as industrial employees.

Two questions should be kept in mind when industry expresses itself:

1 What type and how much training should the colleges provide to meet industrial needs?

2 What effect will the recommendation have upon the cost of education, both to the student and to the college, and the ultimate effect upon the supply and quality of engineers?

It goes without saying that some of the proposals mentioned earlier will result in greater costs to both student and college. With education already quite expensive it might be necessary to find another means of meeting additional cost to insure a continuing supply of good men. For example, is industry willing to provide financial assistance particularly to private schools, as publicly recommended by Alfred P. Sloan a year or so ago? If plan number (2) is followed requiring a master's degree to learn the specialties, is industry willing to grant a leave of absence to young engineers to return to college for the second degree and, perhaps, some contribution toward expenses? Further, is industry willing to recognize the additional cost of another year of college preparation through adequate additional salary for those who come to it with advanced degrees? The word "adequate" is emphasized because some of the present increases in the salary scale for advanced degrees represent an extremely small return on the investment.

These questions serve to illustrate some of the problems that industry must help to solve if the major problem of selecting the right type of engineering-training program is to be solved. And yet, industry is in a position to help if it is so inclined. This represents, if you please, the first step in mutual co-operation previously recommended.

Teaching Professional Ethics

As a second step, let us examine the part that industry can play in assisting the colleges to teach the ethics of a profession and what constitutes professional behavior. It becomes extremely difficult to impress upon the student the importance of good professional behavior if there is little evidence of the recognition of such behavior on the part of industry. If industry fails to recognize the importance of attaining professional recognition through licensing, membership in professional societies, and the attainment of official position in such societies, there is little point in stressing such activities in college. Unfortunately, this situation exists in large part today. And yet if engineering is to be continued as a true profession, industry must change its attitude in view of the fact that it is the chief employer of engineers. Otherwise all efforts of the colleges along this line will be lost.

Although the author does not wish to get into a discussion of the merits of the licensing laws of the various states, he will refer to them as an example. This Society and other technical societies have long recommended that the colleges stress the importance of obtaining a professional license as soon as possible following graduation. The student engineer is told that this will help to maintain the high standards of his profession and will improve his personal status in the engineering world. Unfortunately, those who have accepted this advice find themselves in for a rude shock when, upon taking employment in industry, they learn that it makes little or no difference to their employers if they seek to obtain professional licensing. It does not take long for this information to filter back to colleges so that any efforts on the part of the faculties to sell the idea of licensing fall upon deaf ears. If the benefits to be derived from licensing are to be maintained, industry must find some means of fostering a desire on the part of its younger engineers to avail themselves of the privilege, either through added compensation or some other form of recognition.

Technical-Society Activities

In a like manner, those of us who have become closely associated with technical-society activities, find an amazing lack of interest on the part of many employers in the extent to which their engineers participate in society affairs. Not only is no effort made to encourage participation but in some instances it is even frowned upon. It is difficult to understand why any employer should take this attitude when the benefits of self-improvement far outweigh the value of time consumed in society activities. This again reflects upon the teachings of the colleges who encourage student participation in society work and urge him to continue his active affiliation upon graduation. Somehow industry should be made to realize that the colleges will be assisted materially if engineers are encouraged to take active part in society work, and at the same time industry itself will benefit from the increased knowledge and experience of its own employees.

Adequate Compensation

As a third point in discussing the mutual co-operation of industry and the colleges, the manner in which engineers are compensated should be mentioned. The current shortage has caused salaries to rise as will happen when the demand for any commodity exceeds the supply. It is fair to state, however, that based upon the pattern existing before the shortage developed, only the current shortage contributed to salary increases and not recognition by employers of the true value of engineers to their organizations. This, in the author's opinion, is a serious charge against industry and one to which considerable thought and reflection should be given. If the situation continues, industry may find itself in serious trouble. Some business organizations already have discovered this fact.

Recent studies have disclosed that engineers are a shining example of the so-called white-collar class caught in the squeeze of the inflationary spiral. Their salary increases have not kept pace with increasing costs of living and the total earnings are far below what they should be when compared with the increased costs of obtaining the necessary education to practice engineering. Furthermore, there is ample evidence that rank discrimination in setting salaries exists which contributes fuel to the fire. For example, last year in the author's own institution, several June graduates went to work for starting salaries higher than those paid then to graduates from the preceding year on the same company's payroll. Obviously, this was a simple expedient by the company to get men who otherwise would not have accepted employment. But it cost respect, loyalty, and performance, if not an employee himself, by so doing.

Collective Bargaining

As many are aware, there is a growing movement on foot to organize all engineers for collective-bargaining purposes on a national scale. Most of this activity is the result of a desire on the part of employed engineers to improve their economic status. It should be unnecessary to remind the reader that the surest way to kill engineering as a profession is for engineers so to conduct themselves as to classify their occupation as a trade. Yet that is exactly what the current activities of national organizations which seek to organize all engineers for collective-bargaining purposes will accomplish. This is something for which all engineers should have deep concern. But it should be of even greater importance to the industry which hires engineers unless it is anxious to acquire another trade union to be dealt with across the bargaining table. It is doubtful if there is any industry which would admit to such a desire. Yet, as a result of the general level of compensation for engineering employees, many such employees are forced to accept the collective-bargaining concept to improve and protect their economic status.

Student Chapters of Union

All of this may seem unrelated to the co-operation expected from industry by the colleges but there is a very definite connection. The one large national collective-bargaining organization for engineers has the stated objective of installing student chapters of the organization in all of the engineering colleges and universities in this country. It is difficult to conceive of any other purpose than that of indoctrinating engineering students in the collective-bargaining concept by the maintenance of such student chapters. If, and when this happens, the colleges not only will have the responsibility of teaching professional ethics and professional behavior, but also the job of combating propaganda disseminated by the union's student chapter.

Unless industry demonstrates that it is unnecessary for engineers to resort to collective bargaining for the improvement of economic status, the colleges will have little chance of convincing students that they should continue to look upon engineering as a profession. After four or more years of indoctrination while in college and without any convincing evidence to the contrary, most if not all graduates will be willing to embrace collective bargaining. Regardless of the success of current activities to promote the growth of engineering unions their ultimate success will be assured through student chapters if something is not done to counteract them. Industry must provide means for doing this.

Industry Co-Operation Needed

Thus we have a picture of some of the problems facing the colleges today, the solution to which, in large part, can be furnished by the co-operation of industry. The colleges are ready and willing to do their part. However, we must have assistance from industry and some of it must come soon if we are to accomplish our purpose and mission in life.

What Industry Can Do to Help

1. Inform the colleges on changing needs of industry requiring additional or improved engineering training.
2. Offer advice and counsel relative to the extent and type of engineering curricula best suited to industrial needs.
3. Give adequate recognition to the value of advanced degrees to those who acquire them before seeking employment.
4. Co-operate with engineering employees by making possible further education at least by giving them the time needed and preferably including financial assistance when required.
5. Give serious consideration to aiding recognized engineering colleges to meet rising costs thereby insuring the company's own future.
6. Utilize engineering manpower to better advantage and recognize individual ability and initiative.
7. Eliminate discrimination and compensate engineers on the basis of their true worth.
8. Aid the maintenance of professional standards through a proper recognition of professional licensing and technical-society activities.
9. Assist the colleges to combat the growing menace of unionization by furnishing concrete evidence that it is not necessary.
10. Stand ready at all times to offer the services of engineers and managers when they can be of assistance to the colleges.

THE POSITIVE horror with which most scientists and philosophers of science view the intrusion of value considerations into science is wholly understandable. Memories of the conflict, now abated but to a certain extent still continuing, between science and, for example, the dominant religions over the intrusion of religious value considerations into the domain of scientific inquiry are strong in many reflective scientists. The traditional search for objectivity exemplifies science's pursuit of one of its most precious ideals. For the scientist to close his eyes to the fact that scientific method *intrinsically* requires the making of value decisions, and for him to push out of his consciousness the fact that he does make them, can in no way bring him closer to the ideal of objectivity. To refuse to pay attention to the value decisions that *must* be made, to make them intuitively, unconsciously, and haphazardly, is to leave an essential aspect of scientific method scientifically out of control.

What seems necessary is nothing less than a radical reworking of the ideal of scientific objectivity. The naive conception of the scientist as one who is cold-blooded, emotionless, impersonal, and passive, mirroring the world perfectly in the highly polished lenses of his steel-rimmed glasses is no longer, if it ever was, adequate.—*The Scientific Monthly*, September, 1954, p. 153.

Powder Metallurgy Takes Its Place in Industry

Advantages and savings from rapidly growing methods of producing metal precision parts

By Robert Talmage

Powder Metallurgy Consultant, New Canaan, Conn.

FIVE-THOUSAND years ago the Egyptians, using the earliest known method of producing ferrous objects, made some rather good steel by reducing and forging iron-oxide powder attained from crushed ore. Rebirth of the method did not occur until just prior to World War II when a good quality of iron powder became available and the continuous controlled-atmosphere furnace operating at 2050 F was developed. The first production of structural parts took place in 1937, but in the 17 succeeding years the industry has expanded rapidly because of its many inherent advantages.

Today more than a hundred sintered parts are used in automobile manufacture and an equal number may be found in the fittings and equipment of many new homes. Besides these large fields, the office-equipment, toy, hardware, sporting-goods, ordnance, and other industries are using the material in ever-increasing quantities.

This expansion has brought the industry to the point where it is today producing an excess of 4,000,000 parts per day in a total of more than 60 different plants. Copper and iron-powder consumption is running a combined total of over 4,000,000 lb per month. While these figures are not great compared to other methods of production, they are surprising when it is considered that the industry is so relatively young and produces very little scrap.

Cost Savings

This rapid growth has been caused basically by the cost savings possible, which quite often are 50 per cent or more compared to conventional methods of fabrication. Figures even as high as 90 per cent have been obtained in special cases. In addition, many manufacturers are finding that there are other hidden savings—advantages which do not appear in the usual cost comparison.

In order to illustrate the advantages of the sintered-metal process, the manufacturing details of a particular part will be described. This part is in actual production in the Powder Metallurgy Department of the Lux Clock Manufacturing Company, Waterbury, Conn. The part is the alarm verge hammer which replaces one produced previously by conventional stamping and machining methods. The number of parts was reduced from six to three because the verge points have become a part of the lever instead of separate pins. Also, the adjustable threaded stop pin is now a projecting rib on the sintered part. The head is now an integral piece on the sintered part but a small pin at this point cannot be formed integrally and has to be assembled along with the main shaft.

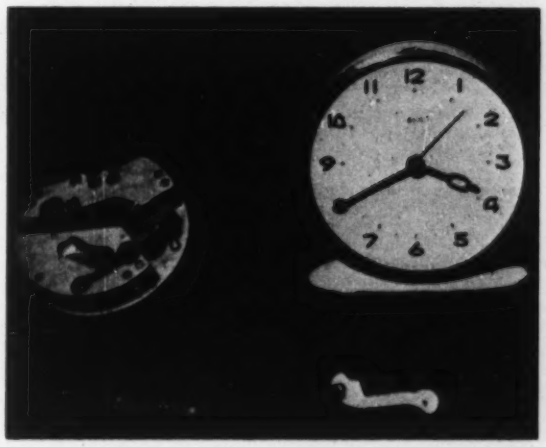

Fig. 1 Finished clock and uncased clock mechanism which utilizes sintered-steel alarm verge hammer

Fig. 1 shows the part as assembled in a clock mechanism and also one of the clocks in which it is used. The hammer is actuated by a stamped-brass star wheel and strikes a steel bell mounted outside the mechanism shown. The part is being produced at a cost savings of about 80 per cent. To date more than 300,000 have been made. It is typical of parts and savings which often are possible when intimate knowledge of the method is available to the product designer.

Manufacturing Process

The conventional production of structural parts from sintered metal depends on two basic phenomena. One is that finely divided metal powders will bond together weakly when compacted at high pressure, and also that compacted powders will bond together strongly when heated to relatively high temperatures under controlled conditions.

Some powder-metallurgy products, such as hot-pressed tungsten carbide, do not utilize these phenomena but the largest production, by far, does, and this discussion will be confined to that type.

The actual manufacturing process starts with the blending of various powders, which are purchased on a minimum inventory basis. The formula used and the approximate prices of the powder are as follows:

Contributed by the Metals Engineering Division and presented at the Semi-Annual Meeting, Pittsburgh, Pa., June 20–24, 1954, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Fig. 2 Octagonal steel-type tumbling barrel used to blend or mix powders prior to pressing

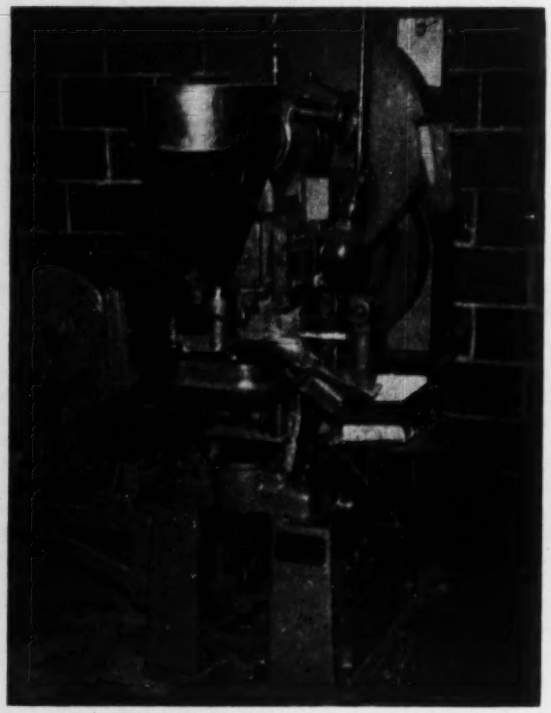

Fig. 3 Twelve-ton double-action briquetting press with tools used to form alarm verge hammer

Material	Cost per lb in cents
96 parts 100-mesh sponge iron	12
3 parts 100-mesh copper	42
1 part 325-mesh graphite	62
1 part zinc stearate	50

The sponge-iron powder has a normal low-carbon-steel chemical analysis and the graphite is added to increase the combined carbon in the final product to about 0.7. The copper is added to get somewhat higher strength (50,000 psi plus) under normal sintering conditions. The zinc stearate is an excellent dry-powder lubricant and serves to facilitate pressing and ejection only, since it passes off completely during the sintering operation.

The blending or mixing operation is accomplished in the tumbling barrel shown in Fig. 2. It is a conventional octagonal steel type equipped with a cover to prevent leakage of the finer particles. It has a maximum capacity of about 300 lb of powder, and the mixing time is 1 hr. From this machine the powder mix is poured into small pails and transferred to the briquetting press shown in Fig. 3. It is a 12-ton-capacity double-action machine of relatively simple construction which has a maximum speed of about 45 strokes per min. The press operator pours the mixed powder into the hopper which in turn feeds the shoe that shuttles over the die during a portion of each cycle of the press.

Fig. 4 is a close-up of the tools in the press. The powder flows from the shoe into the cavity created by the die when the lower punch has receded below the surface of the die to the fill ratio of $2^1/_2$ times the final thickness of the part. The shoe then backs away from the cavity so that the upper punch can approach and enter the die in order to compress the powder against the lower punch at a pressure of 30 tons per sq in. After compression the upper punch retracts and leaves the die, allowing the lower punch to rise and eject the briquette or compact. The lower punch stops flush with the top of the die for a sufficient length of time to allow the filler shoe to push the compact off the punch and start another cycle.

The total pressure used to form this hammer is about 6 tons for the area of 0.2 sq in. Each part weighs $2^1/_4$ grams and a weight tolerance of 1 per cent is maintained.

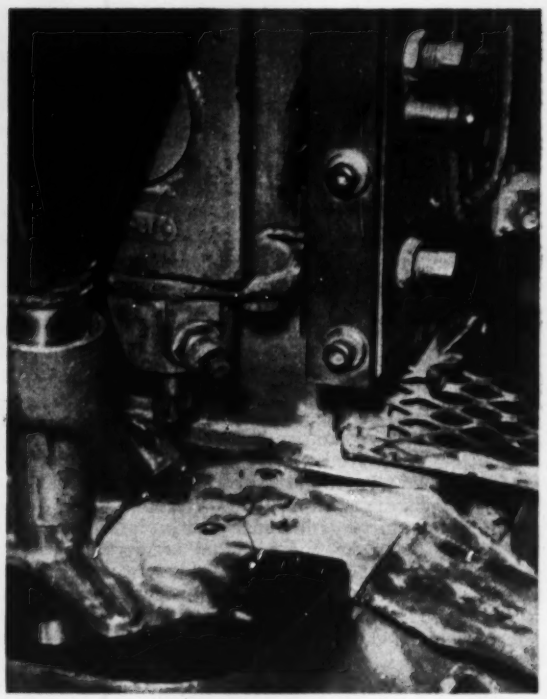

Fig. 4 Close-up of tools mounted in press showing upper punch over die and filler shoe pushing briquetted part aside

Production is approximately 1500 pieces per hr with one operator watching two presses. Set-up time normally is less than 1 hr. The tools used are shown in Figs. 5 and 6. The die is made from steel-cased tungsten carbide, the punches from oil-hardening tool steel, and the core pins from high-speed tool steel. The full set of tools costs about $1500 and the die will produce several million parts before wearing 0.001 in. With proper care, the punches need only to be resharpened about once every 200,000 pieces or more. The steel core pins need to be replaced every 100,000 to 200,000 pieces in order to hold the tolerance specified.

Sintering the Parts

As they leave the press, the parts are rather fragile because they are bonded only by molecular attraction or incipient welding since no binder is employed. They are sufficiently strong, however, to be allowed to fall automatically a short distance into a tote tray. When handled correctly, very few are broken before reaching the sintering furnace.

The furnace used for sintering these parts is shown in Fig. 7. It is a gas-fired full-tunnel muffle, of the hand-pusher type, utilizing a 3-in. × 12-in. D-shaped metal muffle with a heating zone 36-in. long between brickwork. A 3-ft preheat section and a 6-ft water-jacketed cooling section are provided. The operating temperature, for these parts, is 2050 F and the filled 12-in-square graphite sintering trays are pushed through at a rate of one every 10 min. The trays are loaded with about 500 pieces each for a total production of 3000 pieces per hr with a total time in the furnace of 2 hr from door to door. One operator normally can handle three of these furnaces without trouble. The temperature control is a single standard-type potentiometer operated from a thermocouple situated outside the muffle. Fig. 8 shows the exit end of the furnaces including an operator removing a tray of parts from the cooling zone. Two gas-fired atmosphere generators also are shown.

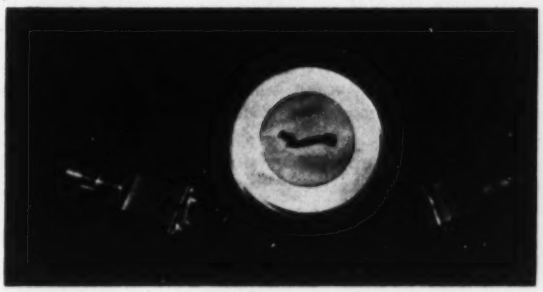

Fig. 5 Tools used to form alarm verge hammer showing—left to right—lower punch with core pin in position, die with tungsten-carbide insert, and upper punch

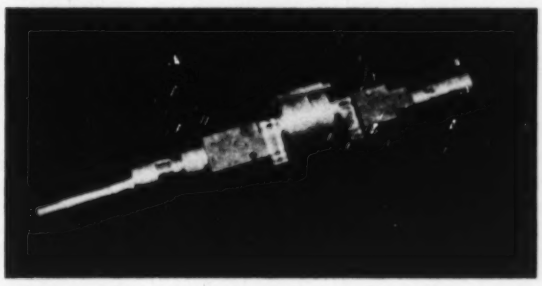

Fig. 6 Tools of Fig. 5 assembled in pressing position

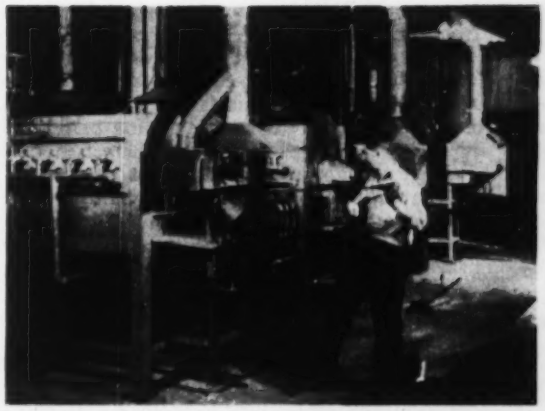

Fig. 7 Entrance end of sintering furnaces showing operator about to push a tray full of parts into entrance zone

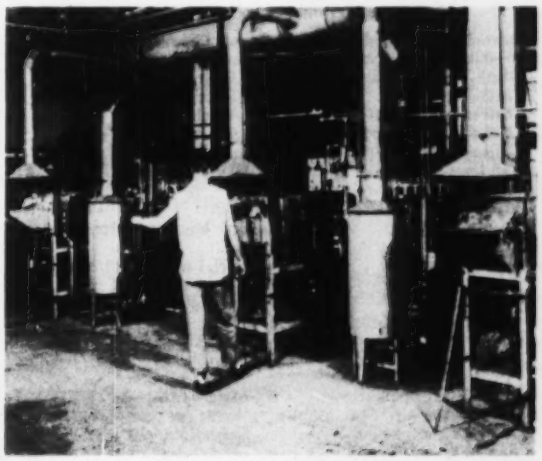

Fig. 8 Exit end of furnaces with operator removing tray of parts from cooling zone; two ammonia dissociators are shown

A reducing atmosphere is necessary during sintering to reduce the oxides present in the compact as well as prevent their formation. The atmosphere used in this case is dissociated ammonia (75 per cent hydrogen and 25 per cent nitrogen) produced by a gas-fired generator from bottled ammonia. The atmosphere is introduced into the furnace just behind the heating zone and flows both ways to exits at each end of the muffle.

Checking Finished Parts

When removed from the furnace, the parts are extremely clean and free from any oxide when handled correctly. They are spot-checked periodically by an inspector for hardness and size. A Rockwell B 50 to 70 is specified to control hardness and strength while size is checked to specified drawing tolerances. No allowance is made in the tools for the slight shrinkage which occurs in sintering because it is about the same as

the slight expansion which takes place when the part is ejected from the die in the briquetting operation.

After leaving the furnace the pieces are dry-tumbled by themselves to remove the sharp edges on corners and to polish the wear surfaces. This is accomplished in a small, bench-type, octagonal steel tumbling barrel and takes about 1 hr. The parts are then immersed in a hot oil bath at a temperature of 170 F for 3 hr, to impregnate them with a lubricant which serves to provide some self-lubrication and rust protection during use. After impregnation the operations are completed by packing them for shipment to the assembly department.

Advantages Claimed for Process

From this description of the actual methods used for production of a sintered part it can be seen how relatively few operations are required to produce a precision-steel part from a low-cost raw material. Table 1 compares this method, including the assembly of two pins, with the previous methods. It can be seen that not only was the number of parts reduced by $^1/_3$ but also the number of operations was reduced by 10. The labor hours saved were 18.27 per 1000 pieces or 84 per cent and the material cost savings was $4.21 per 1000 pieces or 74 per cent.

Table 1 Operations Required to Produce Alarm Verge-Hammer Assembly

By conventional methods	By sintered-metal methods
Lever—0.055-in. brass strip	Lever
1 Blank, spot, and pierce	1 Press
2 Drill shaft hole	2 Sinter
3 Drill stop-pin hole	3 Tumble
4 Drill first verge-pin hole	4 Oil impregnate
5 Drill second verge-pin hole	Assembly
6 Tap lever-screw hole	1 Drive two pins
Hammer head—0.250-in-square steel	
1 Turn	Labor hours required—3.43/1000 pcs
2 Degrease	Material cost—$1.47/1000 pcs
Lever screw	
1 Turn	Number of operations—5
2 Degrease	
3 Nickel plate	Savings effected
Assembly	Labor hours—$18.27/1000 pcs = 84 per cent
1 Drive shaft	Material cost—$4.21/1000 pcs = 74 per cent
2 Drive 2 verge pins	Operations—10
3 Position 2 verge pins	
4 Assemble screw	
5 Assemble and stake hammer head	
Labor hours required 21.7/1000 pcs	
Material cost—$5.68/1000 pcs	
Number of operations—15	

Other "hidden" advantages gained include:

1 Better wear resistance resulting from self-lubrication.

2 Reduced inspection requirements, resulting from reduced number of parts and extreme uniformity of product.

3 Reduced purchasing, inventory, and production-control problems.

4 No scrap or scrap-handling problems.

5 Reduced possibilities for error because so much is incorporated in a set of tools that have an extremely long life.

This part and its many advantages illustrate why the manufacturer has found so many uses for the process. Today more than 50 different sintered parts are in production for various clocks and clock mechanisms which are both mechanically and electrically powered.

Cost advantages usually are the controlling reason for using sintered-metal parts today but more and more designers are beginning to realize other advantages. Some of these are listed in comparison with various other methods of production:

1 Some self-lubrication can be provided even in hardened steel.

2 Smooth and straight contours can be produced on all sides and in holes without extra operations, including blind holes.

3 No tapers are required for most shapes.

4 A great variety of materials can be produced by the same tools.

5 Little or no scrap loss is encountered.

6 Sharp corners and edges can be produced easily.

7 Little or no flash or burrs are produced.

8 Greater uniformity of product is possible because one tool can produce millions of parts.

9 Less inspection is necessary.

10 Better finish is relatively easy.

11 No skin effect is present.

12 No special raw materials normally are necessary for specific parts such as special rod, sheet, and so on.

13 Face contours can be formed easily in brass, bronze, and steel.

Future Possibilities

While these advantages are specific for various parts, there are other broad factors indicating future possibilities which are much more important. Owing to the increasing metal requirements of this age and especially those that might be necessary during all-out production, the powder method of manufacturing metal products has several over-all advantages. Some of these are:

1 Ability to produce precision parts without any scrap loss—thus reducing the requirements for virgin metal and the necessity for handling and reworking scrap metal.

2 Ability to supply precision parts in large quantities with a comparatively low amount of labor, tools, and machinery.

3 Ability to produce basic sheet, strip, rod, etc., on a continuous basis directly from ore.

4 Ability to produce new combinations of materials as aluminum oxide in steel, hardened steel in bronze, etc.

5 Ability to offer more accurate control of chemical analysis and purity.

6 Ability to reduce the possibility of inclusions, stringers, seams, etc.

7 Ability to produce new alloys not possible by casting.

8 Ability to reduce raw-material inventory requirements.

These advantages and the description of the process indicate why this industry is expanding so fast. Some other factors which also are influencing this change include the fact that physical properties have been increased considerably (some sintered-steel parts produced by the method described have over 60,000 psi tensile) and powder costs have become relatively lower.

Estimating—

Effects on Management and Estimators

By C. A. Butler, Jr.

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The need for accurate estimates is a real one which is growing more and more acute. The increase in ratio of investment costs to operating costs in heavy industry makes it more important than ever before that engineers make the most economical designs possible. To do this, estimating must be done almost continuously during the progress of the design to insure that the design is most economical.

In a contractor's organization the estimator's objective is to acquire profitable business for his company. If the estimator consistently estimates too low the firm doesn't stay in business very long, and if he "plays it safe" and estimates too high the firm doesn't get any contracts. Because the estimator's job is a delicate one—the confidence in which he is held by management and the knowledge and skill with which he supports management are vital elements in the relationship.

The estimator's work may be the basis upon which a proposed project may be built or rejected. The importance of the estimate in making a firm decision to construct or not to construct is becoming more and more important.

The Estimator's Dilemma

The engineering estimator is faced with pressures both actual and psychological when he tackles a project. There may be insufficient time to investigate all phases of the job and prepare a realistic estimate of costs. If he feels that the eventual cost of the project may be greater than a reasonable estimate, he is inclined to make his estimates high. This is particularly so if he feels that management will "rake him over the coals" if the cost exceeds the estimate. On the other hand, if management is all enthused about a job, the estimator doesn't like to "throw cold water on it" and shades it on the low side.

In either event, the responsibility rests on the estimator but management must have a complete understanding of the problem and support him so that the pressures are minimized.

Contributed by the Management Division and presented at the Semi-Annual Meeting, Pittsburgh, Pa., June 20–24, 1954, of The American Society of Mechanical Engineers. (Condensed from ASME paper No. 54—SA-64.)

Hazards of Overestimating

The best way for the estimator to keep out of trouble is to make sure that his estimates are high enough. In so doing it takes a lot of moral courage to keep from making them too high. The estimate must serve as a guide in deciding which of several possible projects should be chosen, so an estimate that is made too high is likely to cause management to turn down an attractive project. Under present circumstances there are so few really good projects that it is a serious error to reject a good one for any reason. An estimate that is too high is dangerous, although perhaps not quite as dangerous as one that is too low.

Overestimating is likely to lead to waste in design and perhaps some waste in construction. On a job where apparently there is plenty of money, it is just human nature not to watch the costs as closely as on one where everyone has to be on his toes to get the project done within the allotted amount. The waste can start on the drafting board because without the necessity of keeping within a tight estimate, the project can be overdesigned and too many frills included.

It must be concluded that overestimating, though not quite as great a sin as underestimating, is still something to be avoided. There is a great temptation to overestimate because criticism of overestimating seldom materializes. A high estimate usually results in the job not being built, so no one ever has proof that the estimate really was substantially high. But though overestimating may be a comparatively safe practice for the estimator, it is not good for the company whose management is making decisions based on these estimates.

Effect of Waste

Since we have just noted that overestimating is likely to lead to waste in both design and construction, let's take a minute to consider the effect of waste. Construction is done but once and if money is wasted in construction it is seldom possible to recover any portion of that money. The waste is a burden on the earnings until the plant has been abandoned or amortized. On the other hand, if waste is discovered in operation there is usually some way to reduce or eliminate that waste. For this reason the importance of guarding against waste in design and construction is greater than the importance of guarding against waste in operation.

During the design stage alternative ways of accomplishing the desired results must be estimated to avoid using uneconomical designs. During construction, accurate estimates must be used to measure construction

efficiency and economy. The importance of being economical in our designs and in our construction work is growing because we no longer can afford the luxury of losing or low-return projects.

It is unfortunate that during recent years when the importance of estimating was increasing, we were operating first under war conditions, then under conditions of postwar shortages, and most recently under conditions of preparation for defense. Too often this has resulted in jobs being authorized and constructed under rush conditions with too little attention being paid to the costs. This may be one reason why so many have not realized the growing importance of accurate estimates in making executive decisions.

Probable Future Trends

Some may ask whether the present situation is temporary or permanent. It is quite likely that prices will rise to compensate partly for greater investment costs. But this will not take place until existing plants wear out or until accountants and tax authorities allow depreciation based on replacement costs rather than on actual costs. The present basis for depreciation is an unfair burden on heavy industry.

The mass-production methods which have been responsible for this country's high standard of living can be applied only to a limited extent in the building of plants for heavy industry and in building special equipment for those plants. But the compensation of labor in the building trades and in the jobbing shops has to be competitive with what these men could earn on production lines. For this basic reason it is almost certain that investment costs will continue to rise with respect to the operating costs.

Operating costs can be lowered by advances in technology. But it is almost axiomatic that the improvements in technology which will tend to keep the operating costs from rising rapidly in themselves will increase investment costs.

The present burden of national debt likely will be increased by the necessity for preparedness against possible attack, and the increased services which the public demands of government. It is quite unlikely that we again will reach an era of profit levels in heavy industry which will permit us to afford a plant which does not make an adequate profit.

Engineer's Responsibility in Estimating

Estimates to be of greatest use cannot be too high or too low. The only way to make an estimate on which it is safe to make a major decision is to make the estimate after complete engineering design, including preparation of detail drawings. Then if we have proper cost data from previous jobs and complete bills of material, a firm estimate can be made. This means that management must bear some blame for poor estimating when the engineer is told to make an estimate without the opportunity to complete engineering. At times estimates are demanded based on extremely meager information.

In such a case the engineer is not relieved entirely of responsibility. It is up to him, when presenting the estimate, to present the probable inaccuracy owing to lack of time. It is possible, though rather difficult, to determine the effect of incomplete design, and other missing data, on probable accuracy of the estimates. If the estimate is presented with a frank statement of its probable inaccuracy, management can make its decision with full knowledge of the chances being taken.

It may be that estimators hate to admit, even under adverse conditions, that their estimates are not accurate. There can be no other excuse for the fact that so many estimates are submitted when the estimator knows that they are based on insufficient data, but neglects to include in the estimate a maximum figure in addition to his best estimate. The spread between the maximum and expected figure should be the most useful way to impress on the dollar-conscious executive the chances taken in making decisions on estimates prepared without complete information.

It is the duty of management to supply the estimating engineers with sufficient and accurate estimating information from cost records on previous jobs, or any other available sources. It is then the duty of the estimators to present the estimates as accurately as possible but to be perfectly frank on the shortcomings of any estimates which result from lack of information, uncertainties in design, or any other cause. When this has been done, there will be an increase in respect for the estimates, but good though they may be, there must be a definite responsibility for meeting the estimates.

Fixing Responsibilities

In a job done under desirable conditions, there is little trouble in fixing the responsibility for meeting estimates. On such a project a preliminary estimate usually results in authorization for engineering only. The designing engineer is encouraged to make his design as economical as possible by the knowledge that if there are too many trimmings or too much poor design, the project when finally estimated will cost so much that it will not be built. The final estimate in that case should be made by the people who are responsible for construction.

In this connection engineers should not feel too badly if they spend months completely engineering a job and then it is not built. Their work in carrying the job to the point where it can be estimated accurately and found to be undesirable is not at all wasted. The work has resulted in the company deciding not to go into something which had been proved to be unattractive.

When lack of time makes it necessary to authorize a job before engineering is completed, it is a little more difficult to fix responsibility for meeting the estimates. At that stage the designing engineer and the construction engineer who builds the job have a joint responsibility for meeting the estimate. In order to fix the responsibility it is necessary, even though the job is authorized, to make a complete and detailed firm estimate when the drawings, specifications, and bills of material are complete. If this estimate is higher than the authorized amount, the increase is due to things that happened during the design. These things are not always the fault of the designing engineer. The construction engineer should expect to build the job for the amount in the firm estimate.

When a job is authorized with meager information, an approximate estimate should be made just as soon as the general principles of design are determined; that is, when flow sheets are completed and the principal equipment sized and priced. An estimate made at that time is a fairly good indication of whether or not the amount authorized is adequate.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Associate Editor*

Fig. 1 Sept Iles dock and terminal has approximately 40 miles of track. Ore trains will haul 60,000 to 70,000 tons per day.

First shipment from Quebec-Labrador iron-ore range . . .

Fig. 2 View of new aluminum smelter and harbor at Kitimat. The plant will eventually produce 1,100,000,000 lb per year.

. . . plus opening of Alcan's Kemano-Kitimat project mark two important industrial Canadian milestones

Two history-making events, both in Canada but in widely separated areas, took place recently: The first iron ore was shipped from the vast Quebec-Labrador iron-ore deposits to Philadelphia by Iron Ore Company of Canada and the first aluminum ingot was poured at Kitimat, British Columbia, by Aluminum Company of Canada. Both of these developments represent great capital expenditures—the Quebec-Labrador project cost some $250 million to build and the Alcan British Columbia project investment totals about $275 million to date.

Fig. 3 View of the dam at the Ste. Marguerite power development during construction

Both are a tremendous tribute to private enterprise and should contribute greatly to the military security and peacetime expansion of North America.

Quebec-Labrador Project

The first shipment of iron ore from the Quebec-Labrador fields was the crowning climax to a monumental task which in four years saw the builders

- construct 357 miles of main-line railroad and terminal yards through a wilderness;
- operate and maintain over this same wilderness the largest civilian airlift in history;
- build and maintain base camps and way stations to house and feed 6900 men;
- construct dock facilities large enough to receive new materials as they arrive, and to ship at least 10,000,000 tons of ore a year when the project got into full operation;
- plan for and start construction of two new townsites to house permanent employees;
- build two hydroelectric plants and necessary transmission lines;
- prepare open-pit mines for operation, construct crushing, screening, and loading facilities; and continue exploration of ore bodies.

To raise the large amount of capital needed and to assure a market for the large tonnages of ore that must be produced to support this project, the original Canadian concession companies and Hollinger Consolidated Gold Mines, Ltd., joined with Republic, National, Armco, Youngstown, Wheeling, and Hanna to form the Iron Ore Company of Canada. The two Canadian concession companies subleased to IOC a portion of the iron ore located in their concession areas, retaining ample reserves of ore to meet all present and future Canadian requirements. Iron Ore Company of Canada took over the task of raising the money, opening the country, and developing the ore. Besides the financing provided by the partners, 19 American and Canadian insurance companies agreed to lend $150 million.

The town of Sept Iles on the north shore of the Gulf of St. Lawrence is the southern terminal for the railroad and the shipping point for the ores of both Quebec and Labrador. Here was constructed a new 1600-ft dock to handle ore carriers, as well as classification yards, a complete ore-handling system, and railway maintenance facilities.

Twenty-four miles away across Sept Iles Bay, Iron Ore Company of Canada joined with the Gulf Pulp and Paper Company to form the Gulf Power Company, which has constructed a 25,000-hp hydroelectric plant to furnish power for the railway and terminal facilities in the area, for the Gulf Pulp and Paper Company, and for the town of Sept Iles.

The Quebec North Shore and Labrador Railway, a common carrier and an Iron Ore Company of Canada affiliate, heads north out of Sept Iles, 357 miles to the Silver Lake yards in the heart of the ore-mining district. It is one of the longest stretches of railroad construction on this continent in this century and the only one in history built by air. The function of the QNS & L is to haul iron ore economically and efficiently.

Airlift Played Important Role

Almost without major exception, every man, machine, part, or pound of food on the project first went up the line by air. There was literally no other way to reach much of the interior. The airlift was operated by Hollinger-Ungava Transport, an IOC affiliate based at Mont Joli.

From October, 1950, until December, 1953, HUT carried a total of 138,700 passengers and flew 170,343,000 lb of freight for a total of 15,263,190 ton-miles. All this was done without so much as scratching a crewman or passenger, although HUT as a matter of course had to fly into single landing strips at the bottom of canyons, in cross winds, and through some of the world's most exasperating weather.

The line operated ten twin-motored and five single-motored aircraft, and two helicopters. In addition, it chartered seven other ships from time to time.

The construction of the Menihek Dam—a hydroelectric project designed to furnish power for the mining operations and townsite—is a typical example of the job the airlift did. There it flew in all the material needed except for some 1450 tons moved overland during the winters

of 1952 and 1953. Loadings reached a peak of some 1,200,000 lb of supplies and equipment a week during 1953, including the 7000 gal of gasoline and fuel required daily to power machinery, and the total 190,000 bags of cement which went into the dam.

Between August and November, 1954, some of the finest iron ore furnace masters have seen in more than a generation will roll down off the Quebec-Labrador frontier. By the late summer of 1955 the project will be in commercial production, and by 1957 it should be capable of supplying at least 10,000,000 tons a year of such ore, and production can be swiftly expanded whenever the needs of the consumers require it.

Known Deposits—417,000,000 Long Tons

The full extent of the Quebec-Labrador deposits is not known yet and will not be known for years. Forty-four proved ore bodies, however, are known to contain at least 417,000,000 long tons of ore. Average iron content is 59.53 per cent (dry analysis). Many other known ore bodies have not been drilled. Deposits averaging less than 50 per cent iron were not included in ore reserves, although tremendous quantities of this lower-grade ore are known to be available and subject to benefication.

The main ore zone is approximately 80 miles long and 6 miles wide; this lies in a larger belt of iron formation which is approximately 225 miles long and 30 miles wide. Geologists anticipate the discovery of new workable iron-ore deposits in this region.

Ore Handling

The first ore shipped is coming from Gagnon deposits in Quebec and Ruth Lake deposits in Labrador. Six-yard shovels will load 34-ton trucks which will haul the ore from the pits to a screening and crushing plant.

Fig. 4 Map showing new Quebec-Labrador iron-ore range

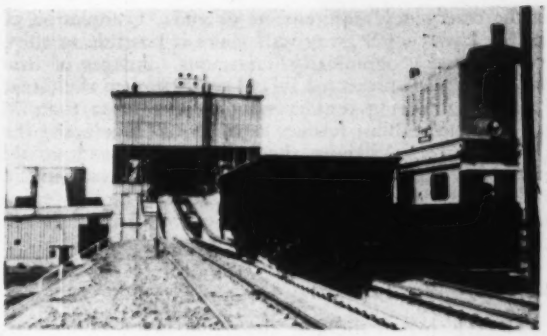


Fig. 5 Here a side-arm pusher running on narrow-gage tracks between regular tracks moves an ore car to a barney pit

Ore over five inches will be crushed. Conveyers will carry the ore from the plant to a loading pocket which will empty directly into cars.

Each train will be made up of 100 to 115 cars, each car carrying 85 long tons of ore. Movement will be accomplished by four 1500 to 1750-hp diesel-electric units over 132-lb rails, the heaviest ever rolled in Canada. Seven to nine trains a day during a 165-day mining season will be required to move 10,000,000 tons.

There are 23 passing sidings along the single-track main line of the railroad so that northbound empties can pull aside for southbound trains. All signals and power switches will be controlled from a centralized traffic-control system operated from Sept Iles. Estimated running time; 15 to 16 hr southbound, 12 to 13 hr northbound.

When ore trains reach Sept Iles the cars are classified into groups according to the chemical analysis of the ore they contain. This permits them to be placed on tracks for dumping in the sequence necessary to make a mixture which meets the selling specifications. Side-arm pushers running on narrow-gage tracks between the regular tracks move cars to a barney pit; from there a barney hoist pushes them two at a time into a two-car rotary dumper. The dumper turns the cars over and dumps the ore much as you would dump sand out of a slipper. Empty cars return by gravity to a yard where they are made up into trains and sent north. The whole two-car cycle can be completed in 65 seconds.

Once dumped, the ore falls onto a belt-conveyer system which can move it either to a ship lying at an 800-ft loading dock at a capacity of 8000 tons an hour (estimated to average 6400 tons) or transfer it to stockpile. In a shipping season running from 200 to 240 days, Sept Iles will see as many as six or seven ore ships a day and several supply ships a week.

Shipping Routes

Between seven and eight million tons a year of the projected 10,000,000 tons production will go by deep-water routes to Atlantic Coast ports. The bulk of the remainder will travel in large vessels to Montreal and there be trans-shipped to Great Lakes ports in carriers small enough to negotiate present canals along the St. Lawrence.

One of the great benefits of an open-pit operation such as the one in Quebec-Labrador is that it can be expanded quickly and easily to meet increased peacetime demands

or the emergency requirements of war. Completion of the St. Lawrence Seaway will make it possible to ship, speedily and economically, enormous tonnages of iron ore over a well-protected inland waterway to the Great Lakes steelmaking centers which have more than 75 per cent of the blast-furnace capacity of Canada and the United States. Without the Seaway, shipments would either have to run the risk of attack while traveling in exposed sea-lanes or they would have to be limited to the quantities that can be moved over existing rail and canal facilities.

Kemano-Kitimat Project

The pouring of the first aluminum ingot at Kitimat, British Columbia, marked the completion of the first stage of the vast hydroelectric and aluminum-smelter project constructed by Aluminum Company of Canada, Ltd. (Alcan).

Spread out over an area of unsettled territory 160 miles in width and 60 miles in depth, this complex development will eventually have a hydroelectric capacity of 2,240,000 hp, the largest ever undertaken by private enterprise. This block of power will supply the largest aluminum smelter in the world having an annual production capacity of 550,000 tons. The first stage of the project now in operation uses hydroelectric capacity of 420,000 hp and will produce 91,500 tons of aluminum annually. Hydroelectric works, transmission lines, and smelter site are capable of rapid expansion with the installation of additional generators and smelter potlines.

Construction of the project has so far required over three years since its inception was announced on April 21, 1951.

Kenney Dam

By October, 1952, more than 6,000,000 tons of rock and clay had been moved into the canyon of the Nechako River to form the Kenney Dam, the third largest earth-filled dam in the world. This man-made mountain backs up the waters in a lake and river reservoir system 150 miles in length. One of the toughest phases of the job was the ten-mile tunnel, 25 ft in diam, which leads the impounded waters through the barriers of the coastal mountains. Hard-rock miners, tunneling in opposite directions, made a junction inside the mountain last December.

In the Kemano powerhouse, a vast cave, one-quarter mile inside the mountain, the three 140,000-hp turbines started to turn over on July 15, 1954, driven by the waters falling 2600 feet through penstocks from the tunnel above. The power surges through a 50-mile aluminum transmission line which crosses a 5000-ft mountain pass between Kemano and Kitimat to "bake" the "pots" in the aluminum smelter.

The newly built seaport at Kitimat, adjacent to the smelter, has been steadily receiving the various materials such as petroleum coke, pitch, cryolite, and alumina through the Panama Canal from Jamaica where another Aluminum Limited subsidiary was the first to acquire bauxite properties and to extract the refined alumina from the bauxite ore. About $30 million has thus far been invested in Jamaica, mainly to support the Kitimat shelter.

Aluminum Production

The company's present production of aluminum in Canada, now centered in Quebec province, amounts to about 550,000 tons per annum, or roughly one quarter of the world's supply. About 85 per cent of this production is shipped to world markets, the largest being the United States and Great Britain, who have found it advantageous to rely on the economical supply in Canada based on abundant resources.

At Kitimat, where only remote Indian tribes peopled the area until three years ago, a modern town is being constructed, based on plans developed by North America's leading town planners. Already a municipal ad-

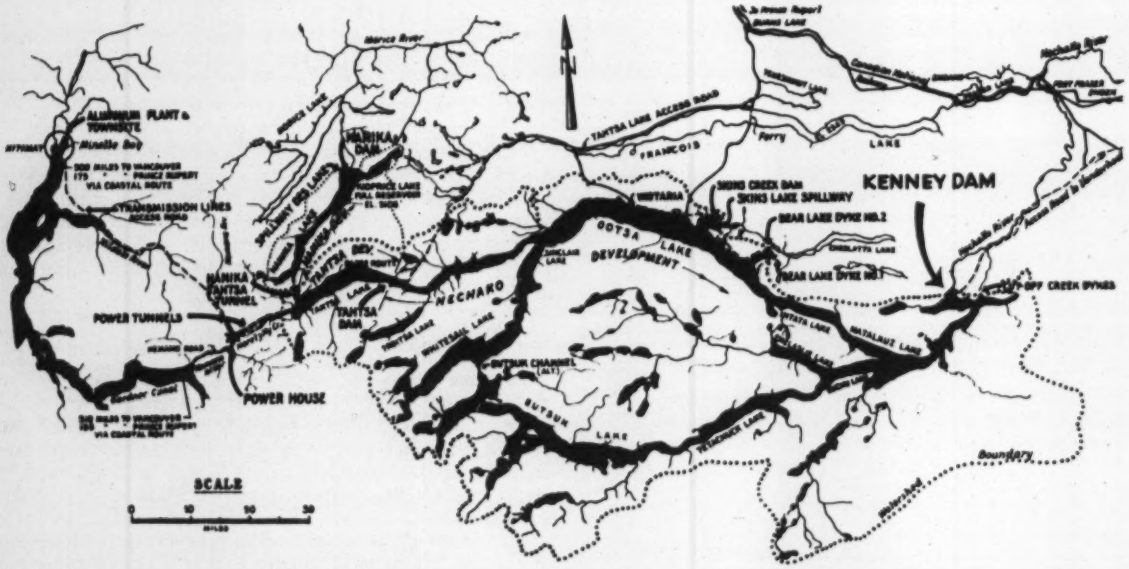


Fig. 6 General map outline showing the relationship of the several divisions of Alcan's B. C. Kemano-Kitimat project

ministration, independent of the company, is operating schools and bringing into existence local services such as roads, sewers, and fire protection. Although aluminum smelting requires fewer workers per horsepower of energy used than any other industry, about 1000 employees will operate the smelter in the initial stages and a population of 6000 is envisaged at this stage. The townsite plans call for a new city of 50,000 when the demand for aluminum justifies this growth.

A 48-mile link from Kitimat to the transcontinental line of the Canadian National Railways will be completed before the end of 1954. During the construction phase, all materials and $25 million worth of construction equipment were brought in by boat or roads through the wilderness. Men and materials for the high transmission lines were supplied by a fleet of helicopters.

The opening of the Kitimat smelter signals a new source of vital aluminum for North America and the free world.

Golden Anniversaries

Both the University of Illinois and Iowa State College this year are celebrating the 50th anniversary of their Engineering Experiment Stations, according to an article in *Science*, June 15, 1954, prepared by W. L. Everitt of the University of Illinois, Urbana, Ill., and J. F. Downie Smith, Fellow ASME, of Iowa State College, Ames, Iowa. These research organizations, the first of their kind in the nation, were founded in the academic year 1903-1904. They have been active and growing in size and concept ever since.

Research Activity Formalized

Before 1903, the authors said, such research as was conducted in engineering colleges was done on an informal basis. In keeping with the systematization of agricultural and forestry research at the turn of the century, and with the industrial efficiency movement, the faculties at both Iowa State and Illinois believed it was necessary to formalize their research activity and provide a means for conducting research programs under the sponsorship of industry, state organizations, and engineering societies.

In addition to furnishing useful information to these sponsors, they recognized that such research projects would provide graduate and undergraduate students with training in research methods and that the knowledge gained by them would represent advances in the science and art of engineering. Both schools also recognized the necessity for publishing research results in order to obtain the maximum benefits from their research programs. This is evidenced by the fact that each station issued its first bulletin during its first year of operation. In the course of the past 50 years, both stations have published numerous bulletins and have contributed, through their research staffs, a still greater number of papers and articles to the technical press.

Today, they pointed out, both industry and government recognize the importance of research in the growth and security of our highly technical society. Three groups—industry, technical societies, and the government—have continued to support research programs in engineering experiment stations and other university-affiliated research organizations.

Industry, either as private companies or through its trade associations, has supported applied research in a variety of fields. Recently, a number of industries, recognizing the importance of basic knowledge to their progress, through gifts and grants have supported projects of a fundamental nature.

Technical societies for many years have supported research programs in their areas of specialization. Furthermore, through their technical advisory and research committees, they have served as co-ordinating agencies for industry-sponsored research being conducted by universities.

The government agencies supported relatively little research prior to World War II. However, during and immediately after World War II, various defense agencies and the Atomic Energy Commission sponsored a considerable amount of both basic and applied research. Often this research concerned complex problems dealing with defense systems and requiring many research workers from different disciplines.

Research Saves Dollars

This is a golden anniversary in another important sense, they emphasized. The application of research results from these two experiment stations alone has saved millions of dollars. Often the returns have been several hundred times the cost of the project to the sponsor.

The results of research on problems related to our national defense are hard to put in terms of dollars saved, but benefits from new equipment, simplification and improvement of existing equipment, and fundamental information needed to make technological advances for the future are vital to the defense program. In these activities, universities, industry, and the government have worked together—each contributing to the over-all program. In addition to conducting comprehensive research programs, these experiment stations, as well as those of other universities, are providing training for research personnel needed to man governmental and industrial research posts.

Engineering Curriculums Affected

Nearly all engineering curriculums, they said, show the effects of these changed concepts; progress has been especially noticeable in such fields as mechanics, thermodynamics, electronics, and solid-state science. At the present time the concepts derived from research in solid-state physics are being utilized in various fields such as metallurgical, ceramic, electrical, and mechanical engineering.

Plans are now being formulated for the introduction of course material into the curriculums of these departments through conferences sponsored by the American Society for Engineering Education and the National Science Foundation. A similar program is being conducted to introduce the concepts of nuclear engineering to various engineering curriculums.

Technical advances through research have also intensified the need for continuing education for engineering and science graduates. Research results provide material for such adult-education programs as short courses, conferences, and seminars. Publication of research results also provides an educational medium for those who wish to keep abreast of new developments.

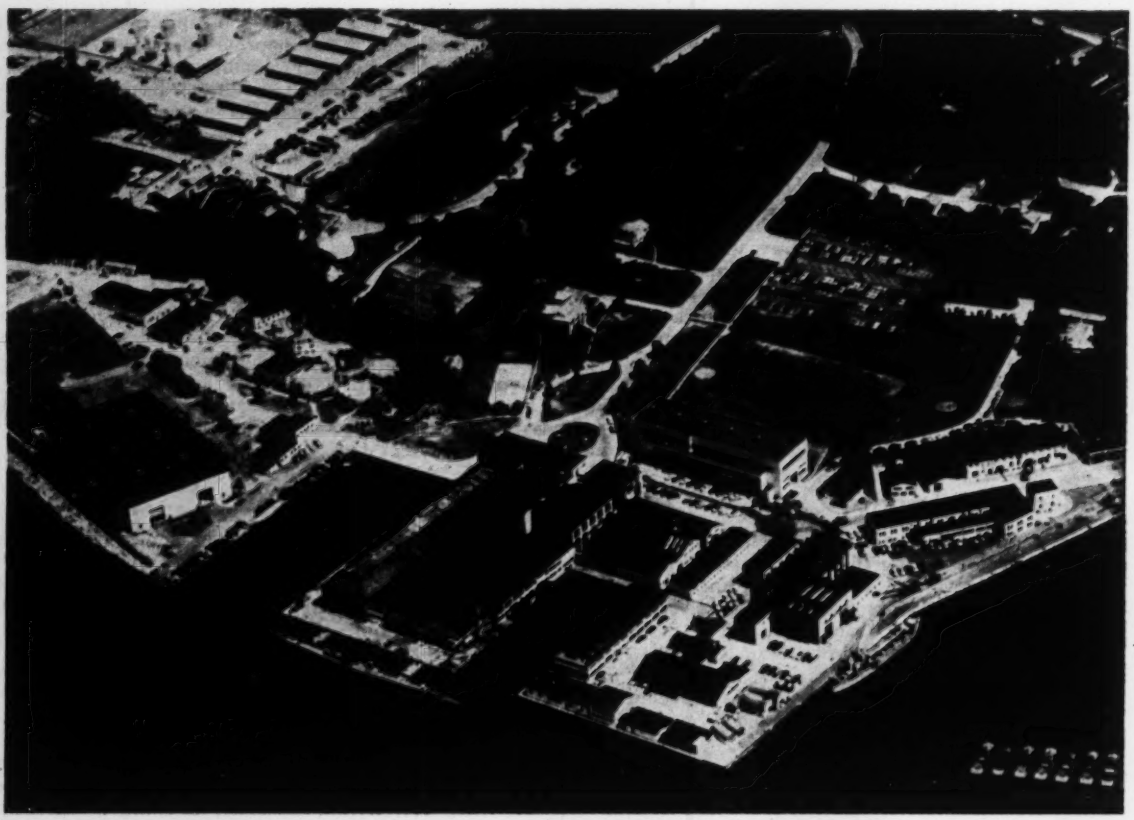


Fig. 7 Aerial view of the U. S. Naval Engineering Experiment Station, which in July celebrated its fiftieth anniversary

Increased Industrial Research

They pointed out that industry is now supporting increased amounts of basic research. In addition to the specialized research program directed toward the direct solution of industrial problems, it is also providing funds for more graduate fellowships to support students interested in research training. These graduate students are in demand for research work in both industry and government. Thus, by means of research grants and fellowships, industry is making possible the training of research personnel as well as receiving the direct benefits of the research program. A great amount of support by industry of university research is highly desirable—particularly if government support decreases.

Navy Experiment Station

The U. S. Naval Engineering Experiment Station at Annapolis, Md., also celebrated its fiftieth anniversary in July. The Station is the Navy's oldest laboratory specializing in the solution of shipboard-machinery problems. Funds for its establishment were authorized by Congress in 1903; the first director reported for duty on July 2, 1904.

The original investment was $400,000; the mission "to test and determine the suitability of certain steam machinery for use in naval vessels."

Today the Station has a plant value of 12 million dollars and its mission has broadened to include the testing and development of new types of power plants and propulsion systems, the quieting of naval vessels to reduce the danger of detection by enemy listening devices, and the continuous improvement of machinery, equipment, materials, fuels, and lubricants.

Orginal plans for the Experiment Station called for its construction on the Naval Academy grounds and for close co-operation between the Station and the Marine Engineering Department of the Academy—even to the extent of having midshipmen run tests. However, lack of space for future expansion at the Academy made these plans impracticable, and the Station was built on its present site across the Severn River from the Naval Academy. Test work was conducted on the Academy grounds until the Station's first building was completed. The first test was on a set of experimental Parsons turbine units.

From a modest beginning with one small building, the Experiment Station, also known as EES, has grown to a 59-acre site with seven major laboratories and supporting shops and facilities. The laboratories are descriptively named: Mechanical, Electrical, Metallurgical, Welding, Chemical Engineering, Internal Combustion Engine, and Wave Mechanics (acoustics and vibration).

The period of greatest growth was during World War II when the number of personnel was almost doubled. The staff went from 600 in 1941 to 1103 in 1944, and

reached a peak of 1262 in 1947. At present there are approximately 1000 civilian employees and 13 naval officers carrying out the Station's engineering service to the Fleet.

Gear Fatigue-Testing Machine

A SPECIAL testing machine has been developed and built by Sonntag Scientific Corporation, a division of Baldwin-Lima-Hamilton Corporation, to simulate service fatigue tests of gears under the loads and at the speeds encountered in normal operation. Developed in co-operation with International Harvester Company, the new machine also permits evaluation of gear lubricants at temperatures between 70 and 350 F.

Test gears can be subjected to torques up to 30,000 in-lb with a maximum tooth load of 14,400 lb. Pinion speed can be varied between 750 and 2500 rpm to transmit a maximum of 1200 hp. Gears up to 10 in. pitch diameter can be tested. Loading-gear face width of $4^1/_8$ in. maximum governs face width of test gears.

Principle of operation is a "closed-box" system in which two gearboxes are connected by two torque shafts. One gearbox loads the other. Only enough input power is required to overcome friction losses since the power output is fed back into the driving gears. The machine is driven by a 15-hp adjustable-speed electric motor.

Test gear and pinion are contained in a gearbox that is fastened rigidly to the frame of the machine. The box containing the drive gear and pinion serves as a lever pivoting on the drive shaft or pinion shaft so that downward force on one end of the lever tends to raise the load gear on the other end. Lever action is freed from the restriction of the rigidly fixed test gearbox by two universal joints in the shaft that couples the load gear and test gear.

Lever action applies load on all meshing gear teeth since the loading gear, in trying to climb up on the loading pinion, is resisted by the torque reaction of the test gears.

The downward force applied by the machine on the lever (load gearbox) is measured by an Emery hydraulic capsule connected to a precision load indicator. The torque transmitted to the test pinion is measured by the Baldwin SR-4 Torquemeter mounted on the drive shaft between the two pinions. The two values can be used for cross-checking.

Speed and torque can be varied while the machine is

Fig. 8 For simulated service fatigue tests of gears and gear lubricants International Harvester Company recently installed a specially designed Baldwin-Sonntag testing machine. Control cabinet (*left*) includes torque indicator (*upper left*) for SR-4 torque pickup, lever force gage (large center dial), oil-temperature controller (*lower left*), and other indicators and controls. The test gearbox is on the right end of the test table (*center*) and directly behind the lubrication cabinet (*right*).

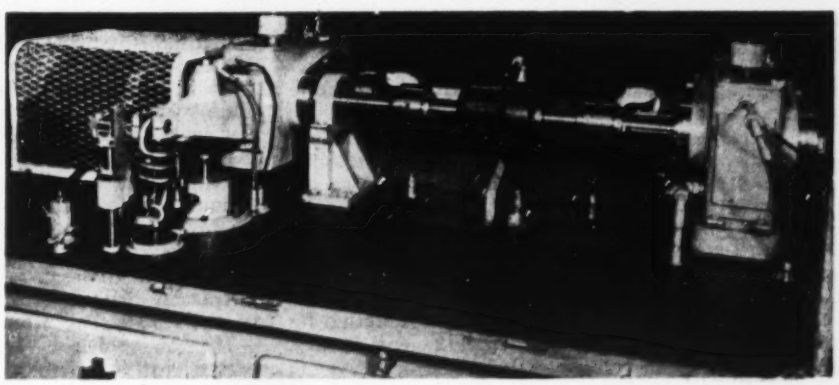


Fig. 9 Test gear and pinion are in the gearbox on the right end of the Baldwin-Sonntag fatigue-testing machine table, mounted on a universal shaft and a torque shaft, respectively. The drive gearbox (*left*) is pivoted on the drive shaft or pinion shaft so that downward force, applied by means of the lever, tends to raise the load gear and rotate it on the load pinion. Universal joints in the shaft eliminate the restriction of the rigidly fixed test gearbox. Torque is measured by the SR-4 torque pickup at the center of the pinion shaft.

running and while watching control-panel instruments which indicate the torque, tooth load, and speed of operation. Other instruments indicate running time, power of the main motor, and the number of cycles to cut off. The unit is designed to shut off automatically at any slight increase in normal operating load or tooth failure and all components are interlocked for proper sequence of operation.

High-Efficiency Power Station

CONSTRUCTION of a $45 million electric power-generating station that will establish new "highs" for efficiency, steam pressure, and temperature is being planned by Philadelphia Electric Company, Philadelphia, Pa.

The 275,000-kw turbine-generator unit—said to be the largest ever ordered—will be built by Westinghouse Electric Corporation. The steam generator for the plant will be built by Combustion Engineering, Inc., and will supply steam to the turbine at the highest steam pressure and temperature of any existing or projected power plant in the world—5000 psi and 1200 F—although initial operation will be at 1150 F. The expected plant heat rate for steam conditions of 5000 psi and 1150 F would be 8400 Btu per kwhr, some 600 Btu less than the heat rate for the most efficient existing power station, according to K. M. Irwin, Fellow ASME, and Philadelphia Electric vice-president in charge of engineering.

Turbine

The tandem-compound, four-cylinder turbine will operate at 3600 rpm, utilizing triple-flow exhaust to the condenser and double reheat. Both reheats will be to 1050 F. All elements of the turbine except the superpressure element are of conventional design using ferritic materials. The first, or superpressure, element will be designed for initial steam conditions of 5000 psi and 1200 F, exhausting at approximately 2400 psi. The second element combines both high pressure and first reheat pressure turbines in a common casing. The third element combines intermediate pressure and single-flow low-pressure turbine in one casing, and the final element is a conventional double-flow pressure turbine exhausting to the condenser at 1.5 in. Hg absolute pressure.

Steam will be condensed in a 105,000-sq ft, single-pass, radial-flow, Westinghouse condenser. Two pumps, each of 75,000 gpm capacity, will provide cooling water to condense the steam. Special precautions will be taken to minimize leakage of circulating water into the condensate system. Nine stages of feedwater heating are contemplated, giving a temperature of approximately 565 F boiler feed supply. Westinghouse feedwater heaters of approximately 31,000 sq ft will heat the feedwater.

Generator

The generator for the plant will be rated at 352,000 kva three phase, 60 cycle, 24,000 volts, 3600 rpm. It will be self-ventilated with shaft-mounted fans and will employ hydrogen inner-cooling of rotor and stator conductors. Hydrogen pressure will be 45 psi. Separate motor-driven d-c generators will provide excitation for the main generator. Magnetic amplifiers will be used to regulate terminal voltage of the generator.

Boiler

The boiler will be a C-E Sulzer Monotube steam generator of the superpressure, "once-through" type and will employ the principle of forced circulation. It will be a twin-furnace design with tangential firing and reheat steam-temperature control by means of tilting burners.

Maximum design steam conditions for the boiler are 6000 psi and 1200 F. At rated load, primary steam flow will be 1,540,000 lb per hr. In the first stage of reheat, steam at 1050 psi will be reheated to 1050 F. Conditions for the second stage of reheat will be 250 psi, 1050 F.

Of the total heat transferred in the boiler, more than 65 per cent will be absorbed in the superheater and the two reheaters. To accomplish this, radiant-wall-type superheating surface will supplement the conventional suspended superheater and reheater sections. Three regenerative-type air preheaters are to be installed.

There will be about 150 miles of tubing, much of it $1^1/_2$ in. in diam. Alloy steels will be used in approximately 80 per cent of the tubing.

Conventional combustion controls will be employed to meter fuel and air in proportion to steam demand. For control of steam and water flow and temperature in the steam-generating unit, C-E Sulzer oil hydraulic-type automatic controls will be employed.

Gas-Turbine-Powered Bus

DETAILS of the new GM Turbocruiser, a GMC transit coach with its conventional diesel engine replaced by a Whirlfire Turbo-Power unit (GT-300), were disclosed recently by W. A. Turunen, of General Motors Corporation, during the summer meeting of the Society of Automotive Engineers in Atlantic City, N. J.

This unit was the first built by GM Research Laboratories' Gas Turbine Department on the assumption that if the turbine eventually enters the ground-transportation field, it is likely to appear first in heavy-duty commercial vehicles.

The Turbocruiser's engine is a single-burner prototype of the 370-hp twin-burner turbine (GT-302) in the XP-21 Firebird.

The Firebird, an aerodynamic single seater, announced in January, was the first gas-turbine automobile built and tested in the United States. The Turbocruiser is the world's first turbine-powered bus.

Mobile Laboratory

Only outward feature distinguishing it from any other transit bus is its wide exhaust stack in the center of the rear deck and absence of rear windows.

Inside, the Turbocruiser is outfitted as a complete mobile laboratory with a large instrumentation panel at the rear end. It has virtually all the instrumentation of a stationary test cell in an engine laboratory.

Two engineering observers can sit in front of the instrumentation console and record data whenever and wherever the Turbocruiser rolls.

The driver's controls are typical of a conventional diesel-powered bus, except for an additional cluster of instrument dials on the driver's right. The controls themselves are conventional.

The new vehicle's Whirlfire unit has the same basic pattern of its "rearranged" Firebird counterpart, consist-

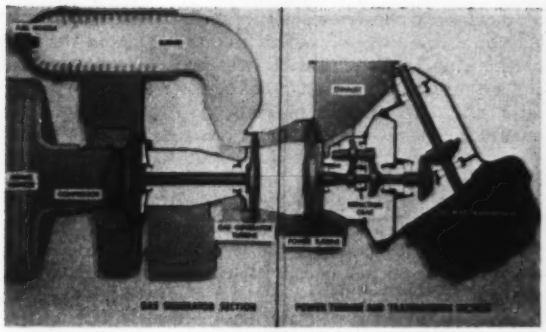


Fig. 10 Schematic of Turbocruiser gas-turbine engine

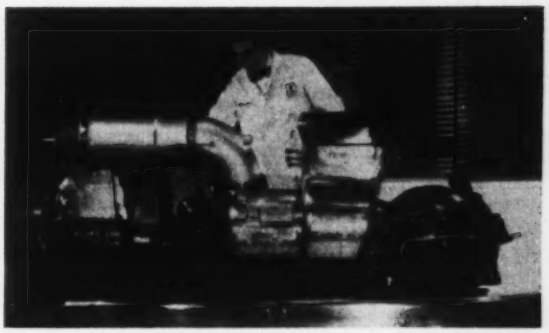


Fig. 11 Complete GT-300 Whirlfire unit ready for installation

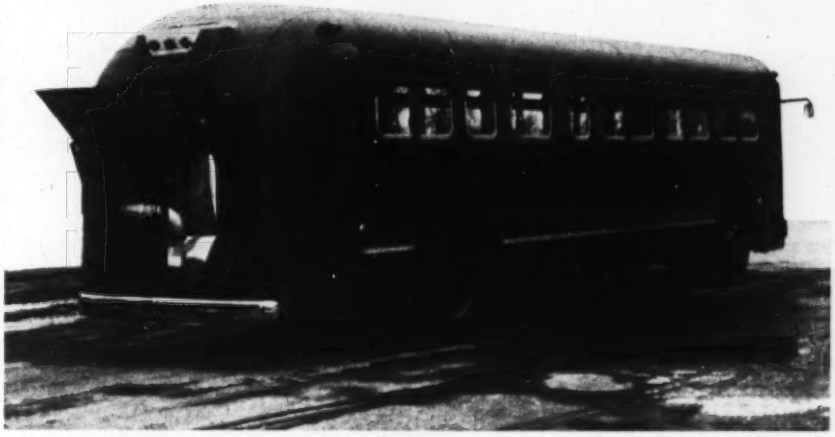


Fig. 12 Turbocruiser coach showing the GT-300 gas-turbine engine as installed

ing of two mechanically independent sections, a gasifier and a power section.

The gasifier provides a source of hot compressed gas. The available energy from the gas is delivered by the power section to the rear wheels.

Mr. Turunen said the Firebird's turbine was designed with essentially the same components as the Turbocruiser's engine. However, because the Firebird's power package had to be more compact than the Turbocruiser's, it became a twin burner rather than a single burner which fitted better into a bus engine compartment.

Simple Open Cycle

Mr. Turunen pointed out that the two Whirlfire engines were built to serve as research tools with which GM engineers hope to isolate basic design problems. Consequently, design of these first engines emphasized mechanical simplicity and reliability.

To conform with the "research-tool" concept, the engines have been operated at relatively moderate turbine temperatures and without regenerators. As a result, their fuel consumption is higher than the optimum which could be achieved.

Mr. Turunen explained, however, that fuel consumption greater than that of piston engines was an anticipated disadvantage. Improving component efficiencies, reducing pressure losses, raising operating temperatures, and using a regenerator are all cited as well-recognized approaches to reducing a gas turbine's appetite for fuel.

Such problems as high operating temperatures, air consumption, large quantities of exhaust gas, engine controls, noise levels, high-speed rotation, durability, maintenance, and starting proved less bothersome than GM engineers had anticipated before either the Firebird or Turbocruiser was road-tested.

Experience with these engines has confirmed, however, that such characteristics as high fuel consumption, lack of engine braking, and delayed acceleration must be improved before gas turbines can compete with present automotive power plants, he said.

Undeveloped U. S. Hydroelectric Resources

A REPORT issued by the Federal Power Commission estimates that hydroelectric power resources available for possible future development in the United States total approximately 88 million kw, with a corresponding average annual generation of about 378.5 billion kwhr.

The report, entitled "Hydroelectric Power Resources of the United States, Developed and Undeveloped, January 1, 1953," estimates the nation's total hydroelectric power resources, both developed and undeveloped, at approximately 109.5 million kw. Approximately 21.5 million kw, or 20 per cent of the total resources, are now developed, producing annually on the average about 112.5 billion kwhr.

The report groups the river basins of the country into 14 major drainages, and the states are grouped into nine geographic divisions, with estimates of developed and undeveloped hydro power shown for each. This breakdown shows that about 44 per cent of the nation's developed hydroelectric power is on the streams west of the Continental Divide. The North Pacific drainage contains about 23 per cent of the United States' total developed power—the largest proportion of any of the major drainages. The Mississippi River basin, comprising four major drainages, has an aggregate hydroelectric power installation of 5,659,275 kw at 362 plants, the largest total installed capacity of any single river system in the country.

A summary of the distribution of developed hydroelectric power by geographic divisions and states shows that the Pacific division, comprising Washington, Oregon, and California, has the largest aggregate development, totaling 6,842,389 kw at 229 plants, representing 32 per cent of the U. S. total.

Hydroelectric plants owned by the Federal government had a total installed capacity of 8,293,520 kw on Jan. 1, 1953, the report shows. The State of Washington had the largest aggregate installation in Federal hydroelectric plants, with a total of 1,976,400 kw. Tennessee was second with 1,399,800 kw.

Turning to the nation's undeveloped hydroelectric power, the report says that about 54 per cent of this potential is in the river basins west of the Continental Divide. The North Pacific drainage, which includes the Columbia River Basin, has the largest amount of undeveloped power of all the major drainages, totaling 33,994,800 kw. Leading the country, the Columbia Basin alone has 30,218,500 kw. The Mississippi Basin is second, with a total of 21,686,600 kw. By geographic divisions, the Pacific Division leads with undeveloped power totaling 30,507,900 kw.

The report indicates that there has been a rapidly increasing trend in hydroelectric power development in recent years in connection with the multiple use of water resources. In 1920 the total capacity installed in hydroelectric plants was only 4,803,000 kw, or 4 per cent of the presently estimated hydroelectric power resources. By 1940 this had increased to 11 per cent, and to 20 per cent at the end of 1952.

Copies of the report may be purchased from the Publications Division, Federal Power Commission, Washington 25, D. C. The price is $1.50 per copy and the order number is FPC P-26.

Supersonic Test Sled Track

Experimental ejection seats and capsules for emergency escape from supersonic aircraft will soon be hurled beyond the speed of sound from a 1500-ft-high mesa in Utah, it was announced by the Air Research and Development Command, Baltimore, Md.

Construction of a 12,000-ft rocket sled track atop the mesa is being planned. The Air Research and Development Command estimated testing of the full-scale emergency escape devices will begin in about a year.

The supersonic military air research track will end at the edge of the mesa. As the experimental rocket sled goes over the mesa escapement, the ejection seat or capsule will be tossed clear. Both the experimental escape device and sled will be recovered by parachute, landing on the floor of the desert. It is estimated the test articles may be thrown from one half to one mile from the edge of the cliff. The escape devices will be instrumented and photographic coverage of the tests will provide detailed engineering data upon which to base design of improved systems of emergency escape from very high-speed aircraft.

To test an ejection seat or escape capsule on the proposed track, ARDC engineers will utilize a pusher sled and test sled. The pusher sled, powered by rockets, pushes the test sled. As the two sleds near the end of the track the pusher sled is halted by a brake device extending downward into a trough of water between the tracks. The test sled continues at high speed until it runs off the track at the edge of the cliff. Just before the test sled slides over the end of the track, the ejection seat or capsule is fired upward.

The test sled will be approximately 15 ft in length, while the pusher will be about 20 ft long. There is no mechanical link between the two. The pusher simply propels the test sled along the track until the pusher's water brakes begin to slow it. The test sled then is given an added boost by a sustainer rocket before it hurdles over the escapement.

Because of the high speeds involved, the sleds are mounted on slippers which slide along a railroad-type track. The new track will be built on designs proved feasible in constructing other such tracks in the past for various Air Force studies.

Dummies will be used to test the ejection seats and capsules at the new site. During the course of a test, extensive data will be collected for analysis of the ejection, parachute opening, and recovery.

Full-scale testing of ejection seats and capsules from aircraft at very high speeds is becoming impractical and expensive. By utilizing a controlled, ground-mounted track equipped with recording equipment, more detailed and accurate information may be obtained, and at less cost. The proposed facility to be built atop the mesa is estimated to cost slightly over $2,000,000.

Atomic-Energy Report

The six-month period, January to June, 1954, covered by the Sixteenth Semi-Annual Report of the Atomic Energy Commission, saw the domestic production of uranium ore and uranium concentrates attain record levels, while production from foreign sources continued to increase. Exploration activity by the Commission, other Government agencies, and by private mining firms and individuals stood at an all-time high in the United States.

Increased availability of raw materials, along with startup of new plant capacity, and operational flexibility of the nation's complex of production facilities resulted in a sharp rise in the production of fissionable materials, at lower unit cost.

During the six months, plant capacity continued to be enlarged, as a number of the components of the Savannah River, S. C., construction project were placed in operation, and construction of additional reactor capacity at Hanford, Wash., proceeded on schedule. Also, the first gaseous-diffusion plant and portions of a second plant at Paducah, Ky., went into operation, while an addition to the Oak Ridge, Tenn., gaseous-diffusion plant was partially completed. Construction of the new

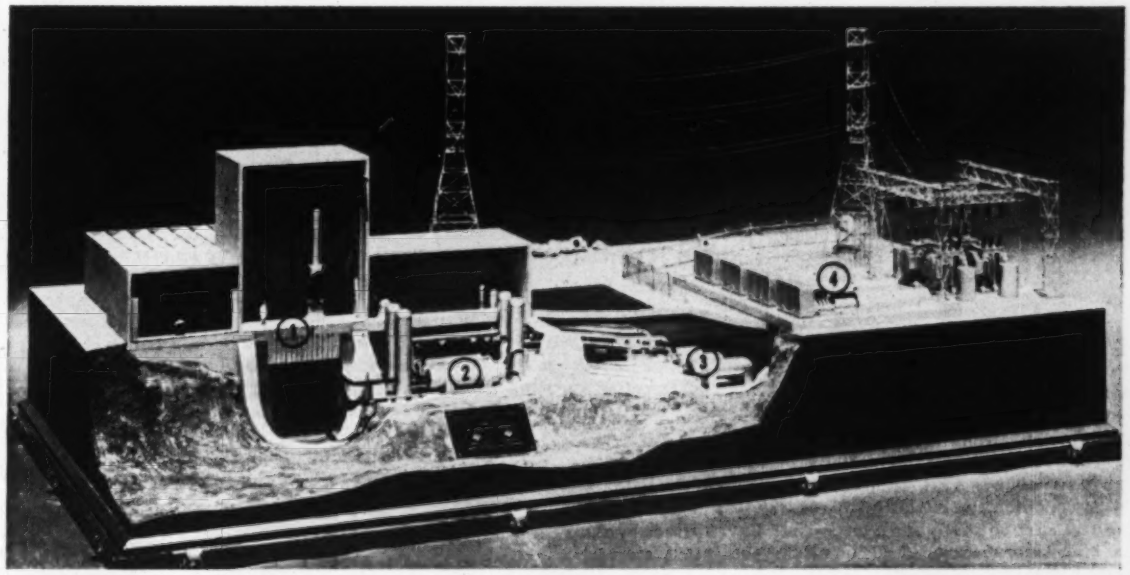


Fig. 13 Showing how electricity is generated from atomic energy, this nuclear power-plant model built by North American Aviation Inc., Los Angeles, Calif., for the U. S. Information Agency is being used as part of the official United States atomic-energy exhibit "Atoms for the Benefit of Mankind," at the São Paulo World Fair in Brazil. Heat from atomic fission in the reactor core (1) is absorbed by liquid sodium and piped to a heat exchanger (2). Heat from first sodium system is transferred to secondary sodium system and carried to boilers to make steam (3). The steam is used to drive conventional turbogenerators to produce electricity (4). Although the model plant is not scheduled for construction, North American recently announced plans to build a sodium-graphite reactor which will produce 20,000 kw of heat from atomic energy.

plant at Portsmouth, Ohio, proceeded satisfactorily.

Largely as a result of this progress in construction, capital investment in atomic-energy plant facilities was estimated to have reached about $5.7 billion.

The weapons research and development program included a successful test series (Operation CASTLE) conducted at the Pacific Proving Ground during the period of this report. Data on radiation exposures resulting from the tests are included in this report.

A contribution to national civil defense was made through the declassification and public release of "Operation IVY"—official film of the test of a thermonuclear device at the Pacific Proving Ground in 1952.

Industrial Nuclear Power

Progress continued in the Commission's program of developing improved reactors for industrial nuclear power and for naval and aircraft propulsion and other military requirements during the first six months of 1954. In a report submitted to the Joint Congressional Committee on Atomic Energy the AEC presented a specific pattern of research and development to be followed during the next five years in a major effort to decrease the cost of power generation with nuclear fuels. It would allow increased participation by contractors presently in the reactor program and encourage additional groups outside the Commission to participate.

The longest practical step yet taken toward the goal of civilian power was the attainment of an agreement with the Duquesne Light Company of Pittsburgh for partial financing of construction of a 60,000-kw version of the pressurized-water reactor for operation by the company. Development work and design of the reactor is being carried out by the Westinghouse Electric Corporation under contract with the Commission. (Ground for the new plant, the nation's first full-scale power reactor, was broken on September 6, 1954.)

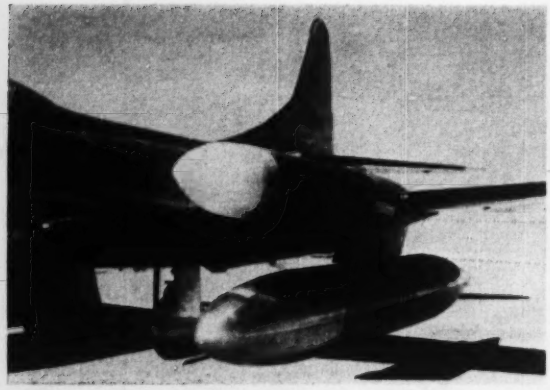
The AEC's work on the power plant for the *U.S.S. Nautilus*, the first nuclear-powered submarine, whose hull was launched by the Navy on January 21, neared completion and the prototype for the second nuclear submarine, the *U.S.S. Sea Wolf*, also was nearly completed.

The mounting interest among industrial concerns in development of nuclear power was evident in the addition of five industrial teams surveying reactor technology and studying reactor designs in research and development during the past six months. This brought the total of such teams to 13.

Research Reactors

Physical research in atomic energy resulted in growth of scientific knowledge, while possibilities for further progress through research remained large. Two new research reactors will be in operation in two of the national laboratories during the year, while three new accelerators went into operation and two others were in the design stage. Interest in research reactors was stimulated at the University Research Reactor Conference held in Oak Ridge in February, by an announcement of AEC policy on lending fissionable material to nonprofit institutions for use in research reactors.

In the field of biological and medical applications, progress was reported on studies of the effects of all types of ionizing and nonionizing radiations on man, animals, and living plants. Emphasis was given to the investigation of the relative biological effectiveness of high-energy particles as compared with x and gamma-rays.

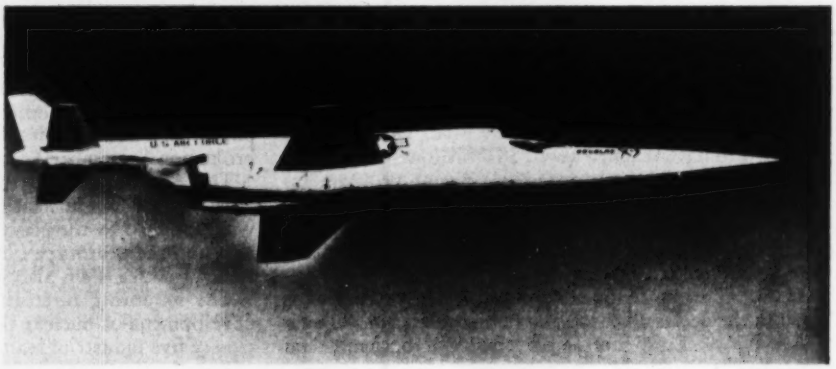


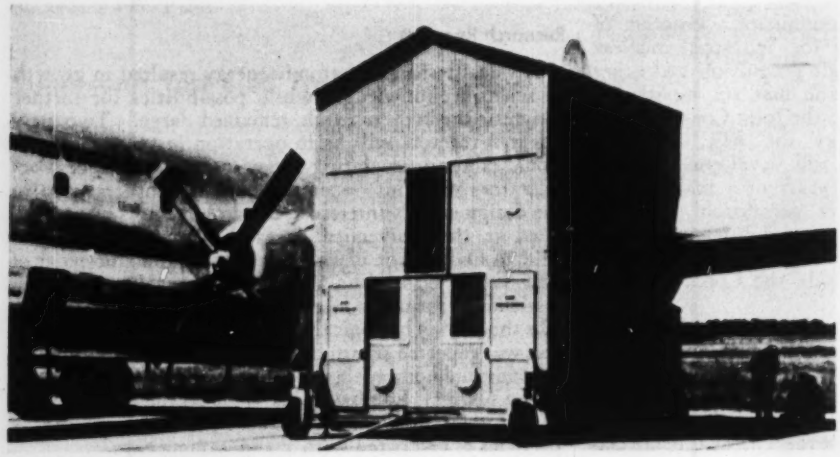
Jettisonable Fuel Tanks. Details of a new system for ejection of jettisonable fuel tanks by forcible means were announced by Pastushin Aviation Corporation, Los Angeles, Calif. The system was installed on the Lockheed F-94C Starfire. Consisting of a simplified jettisonable 230-gal fuel tank and an ejector pylon containing an explosive charge, the system enables safe positive ejection at any speed or possible flight attitude by the jet interceptor. Principal advantages of the system are said to be high firing power, structural strength, and compactness, with only a minimum of frontal area offered to the airstream.

Transsonic Jet Trainer. North American Aviation's modified transsonic jet trainer making its first successful test flight recently. Designed for advance pilot training in high-speed flight, gunnery, and dive bombing, this two-seat trainer is a modified version of the U. S. Air Force's Korea-famed F-86 Sabre Jet. The trainer is rated in the 650-mph class, has a maximum service ceiling of 45,000 ft, and a combat radius of more than 600 statute miles. It is powered by a General Electric J-47-GE-27 turbojet with thrust exceeding 5800 lb.

Aviation developments . . . at a glance

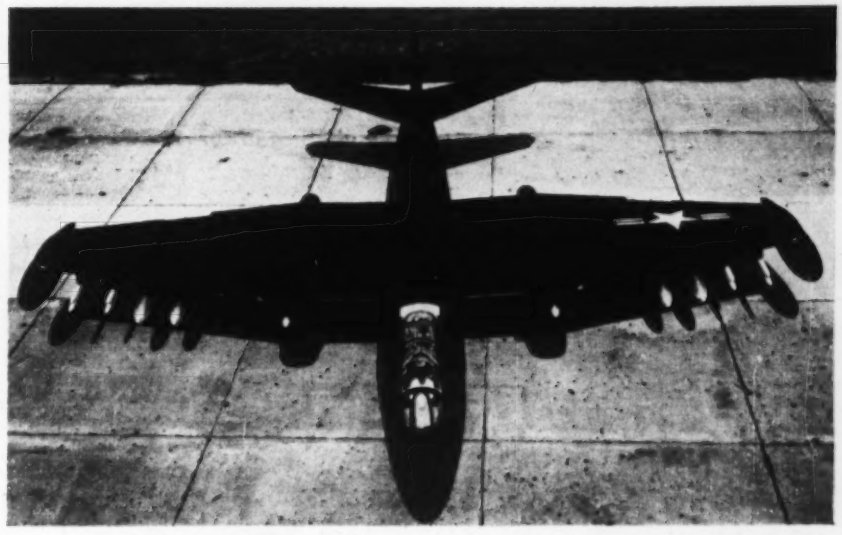
Flying Stiletto. The basic structures for each wing on this Douglas X-3 twin-jet, supersonic research plane, the "flying stiletto," were machined from 2000-lb, one-piece contoured aluminum hand forgings produced at the Cleveland (Ohio) works of Aluminum Company of America. The length of the plane is 66 ft 9 in., nearly three times its wing span of 22 ft 8 in.



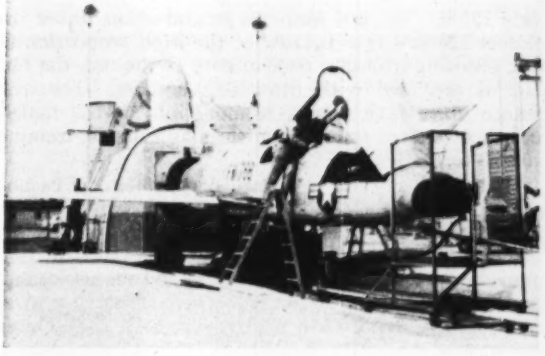


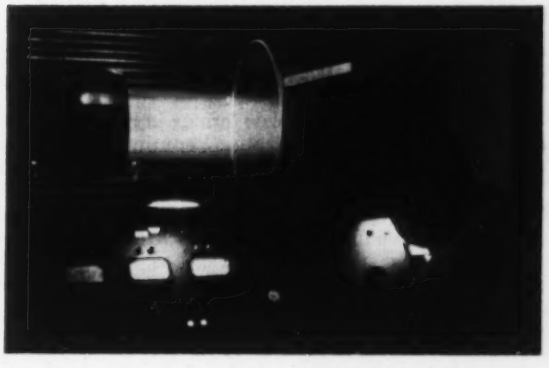
Maintenance Shelter. First completely enclosed, all-weather portable maintenance shelter for B-29, B-50, and C-97 aircraft will soon be in extensive use at United States Air Force bases. Designed by Luria Engineering Company, Bethlehem, Pa., to Air Force specifications, the mobile, low-cost standardized steel shelter will greatly speed up engine maintenance work and enable personnel to perform around-the-clock servicing in any kind of weather or climate. It can be moved into position on aircraft and "buttoned up" by a five-man crew within 25 min.

B-57 Light Bomber. Here's the first picture of the new U. S. Air Force-Martin B-57B to be released showing the powerful light bomber with a full complement of explosives. Visible under the wings are four napalm tanks. Near the wing tips are eight 5-in. high-velocity rockets, four on each side. The armament arrangement is variable. A completely different load could be substituted, depending on the mission and the target. The B-57B also mounts eight 50-caliber machine guns, firing from the forward wing edges.



Realistic Target. Jet-fighter pilots should improve their marksmanship in the near future when they begin firing at this all-metal tow target while zooming along at near subsonic speeds. Designed and constructed by Goodyear Aircraft Corporation in cooperation with Wright Air Development Center, Dayton, Ohio, the target is currently being given extensive tests by GAC and Air Force engineers.





Jet Test Silencer Units. The sound of careful preflight operations, the last production step for F-100 Super Sabres, is sharply reduced in this sound abatement chamber, *left*, on North American Aviation's flight line at Los Angeles International Airport. The tailpipe of the supersonic fighter juts through an opening in the silencer unit where it is fitted with a nearly soundproof asbestos collar. The Super Sabre's J-57 engine is tested alone in another sound-abatement facility before it is installed in the fighter. At *right*, bright bar of flame is shown cutting through the darkened chamber of the sound abatement facility during afterburner operations in acceptance tests of a J-57 jet engine. The spectacular afterburner tests in the dark provide a brief climax to lengthy inspection operations under the chamber's bright lights. Technicians operate and inspect the engines behind two observation windows constructed of four panels of bulletproof glass.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

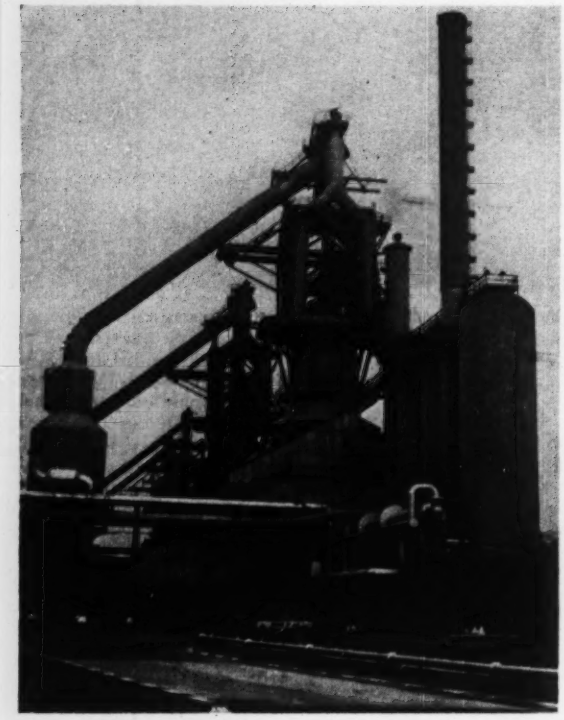


Fig. 1 Queen Victoria blast furnace—the largest in Europe. Behind are the Queen Anne, Queen Bess, and Queen Mary blast furnaces.

Largest Blast Furnace in Europe

THE title of "the largest blast furnace in Europe" is one that has changed hands several times during the past few years. Since July 29 it has belonged to the new "Queen Victoria" furnace of the Appleby-Frodingham Steel Company at Scunthorpe, in Lincolnshire, England, which was blown in on that day by Sir Archibald Forbes, chairman of the Iron and Steel Board, the authority which was established to control the British iron and steel industry when it was denationalized. Except for the commissioning of the remaining two of the four new turboblowers, which are due to go into service in December, 1954, and April, 1955, respectively, this completes a £14,000,000 ($40,000,000) reconstruction scheme that is planned to give an annual output of 1,400,000 tons of pig iron from four furnaces in place of the 900,000 tons previously produced from ten furnaces. Two of the four furnaces, "Queen Mary" and "Queen Bess," date from 1939, but the third, "Queen Anne," is new, having been blown in on March 1, 1954.

The principal feature of the plant is that it has been designed to use a local ore with an iron content of only 20 to 21 per cent—stated to be the lowest percentage of any iron ore used in the world—and to operate on this ore only, with no scrap in the charge. An entirely new ore-preparation sintering plant has been installed, but first an extensive program of research and experiment had to be undertaken, as little was known of the sintering properties of the Lincolnshire ores or of those from the adjacent county of Northamptonshire. The two types of ore are used together in the proportions of 65 per cent and 35 per cent. Extensive tests were also made to improve the quality of the coke. One of the main problems in sintering was found to be the liability of the sinter to mechanical breakdown owing to the presence of free lime in the Frodingham ironstone. This was aggravated by the use of water to cool the sinter, so it was decided to use air cooling. The influence of the lime was reduced, however, if all the raw materials for the sinter plant were crushed to below $^1/_4$ in., and a third stage of crushing was therefore introduced. The throughput of ore is about 100,000 tons a week, the whole of which is crushed to minus $^1/_4$ in.

The "Queen Anne" and "Queen Victoria" furnaces were designed originally to have a hearth diameter of 27 ft, a bosh diameter of 30 ft 3 in., and an effective volume of 42,372 cu ft. The "Queen Anne" was actually built to these dimensions; but the design of the "Queen Victoria" was subsequently changed to give a hearth diameter of 28 ft 6 in., a bosh diameter of 31 ft 9 in., and an effective volume of 44,351 cu ft. The large bell diameter is 15 ft and the throat diameter 22 ft. The height from the taphole to the top of the hopper is 100 ft 2 in., from the ground to the bell platform 121 ft 3 in., and from the ground to the top of the bleeder 224 ft 4 in. Because of the high proportion of slag resulting from the poor quality of the ore, the furnace is provided with three slag notches. The iron runners have four spouts, teeming into 70-ton ladles, and there are ten spouts from the slag runners, teeming into 20-ton ladles.

The hearth bottom is formed of 5 ft 4 in. of carbon over 10 ft of firebrick. The hearth and bosh walls are also of carbon, and the stack is of firebrick. There are 18 hearth tuyères and nine bosh tuyères. Hearth cooling is by stave coolers, 15 ft × 6 in., and the tuyére belt cooling is by 103 copper plates. There are three rows of cigar coolers, with 27 in each row. Both the "Queen Anne" and the "Queen Victoria" furnaces were constructed by Ashmore, Benson, Pease and Company, of Stockton-on-Tees.

The gas-cleaning and sinter plants were constructed by Head, Wrightson and Company, Thornaby-on-Tees, who have supplied four McKee-Head Wrightson sinter machines. The three hot-blast stoves for each furnace, which have McKee chequers, are 22 ft 6 in. in diam and 100 ft high, and have a total heating surface of 100,000

sq ft each. The gas-cleaning plant, which is common to the two furnaces, comprises three static tower washers and five wet-tube electrical precipitators of the type developed by the Research Corporation of America. This plant has a capacity of 12,000,000 cu ft per hr and will clean the gas down to 0.005 grams per cu ft.

The blowing plant, by C. A. Parsons and Company, consists of four centrifugal blowers driven by steam turbines working with steam at 425 psi and 740 F. The blowers are rated to deliver 75,000 cfm at 30 psi when running at 2740 rpm. They take their steam from four John Thompson water-tube boilers of 85,000 lb per hr output each, designed to be fired with either blast-furnace gas or oil. In the week preceding the blowing-in of the "Queen Victoria" furnace, "Queen Anne" set a world record for lean ores by producing 7390 tons of iron, though the designed output was only 6000 tons.

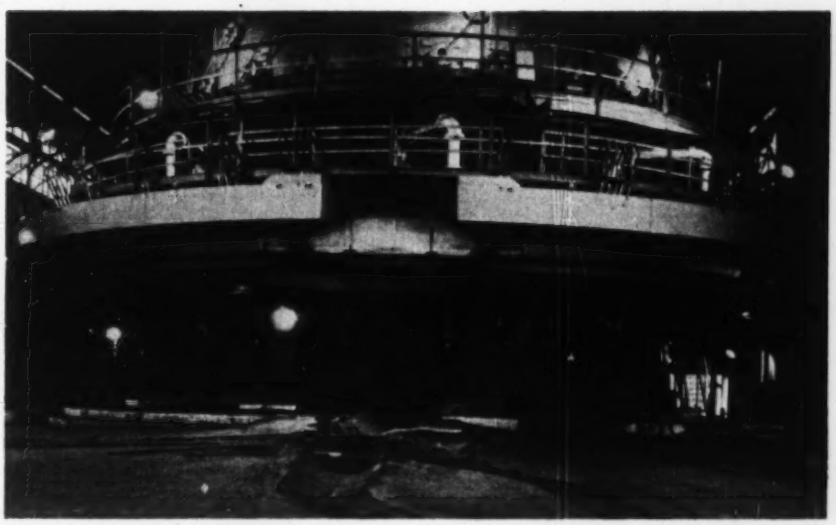


Fig. 2 General view of Queen Anne blast furnace which was blown in on March 1, 1954

Pumping Plant for Dutch Canals

THE Dutch technical journal *De Ingenieur* for July 9 contained a description by Ir. L. Monhemius of a supplementary pumping plant recently installed at Gouda, Holland, for the purpose of raising water from the Ijssel River into the suctions of three existing diesel-driven centrifugal pumps feeding the neighboring canal system. When the river level is high there is a sufficient natural flow into the pump suctions, but occasionally the level falls so low that the pumps could not function. To avoid extensive reconstruction of the pump house foundations and suction culverts, three additional low-lift vertical-spindle pumps have been installed, mounted in vertical guides so that they can be lowered into the water as required and raised out of it when they are not needed, so as not to impede the normal flow. The impellers have a diameter of 2 meters (6 ft $6^3/_4$ in.) and are driven by slipring motors of 165 hp, running at 980 rpm. The drive is through reduction gearing to give a pump speed of 140 rpm. They were constructed by the Werkspoor Company of Amsterdam. The electric cable connections to the motors are protected by being enclosed in flexible aluminum tubing. On test, when working at the moderate head of 10 to 20 cm, the total discharge obtained was 1800 cu meters per min. In Fig. 3 the left-hand pump is shown raised out of the water; the other two are in the working position.

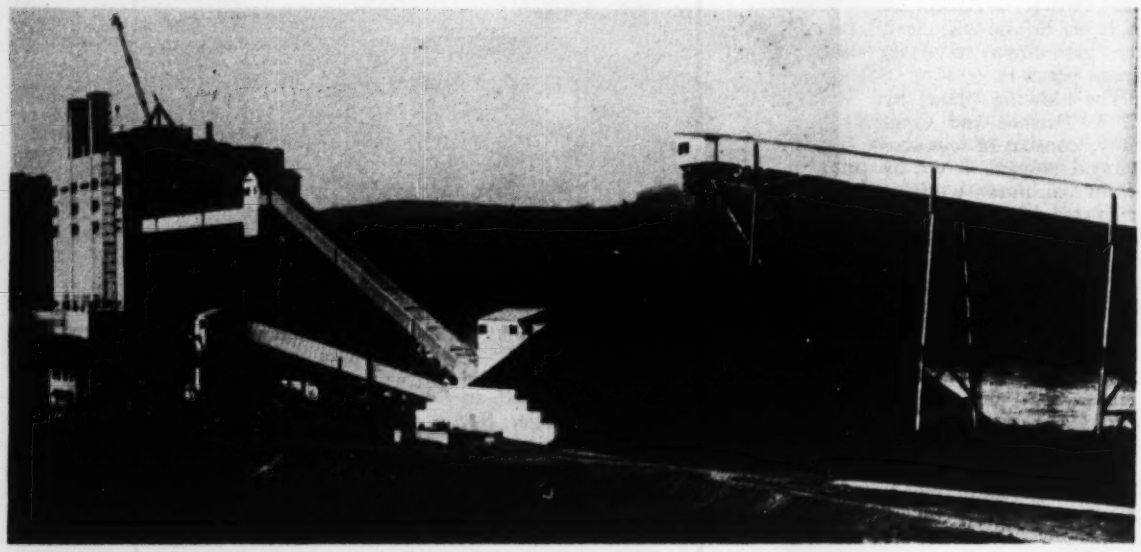
Fig. 3 Gouda pumping station from the suction (Ijssel River) side. The left-hand pump is raised out of the water; the other two are in the working position.

Machine-Tool Exhibition at Milan

THE fourth European Machine Tool Exhibition, which was held at Milan from September 14 to 23, was the most important event of its kind held in Italy since the war. It was organized by the Unione Costruttori Italiani Macchine Utensili under the general direction of the European Committee for Co-operation of Machine Tool Industries and followed similar exhibitions held in Paris, Hanover, and Brussels in 1951, 1952, and 1953, respectively. The 842 exhibitors represented 13 nations and displayed altogether more than 11,000 tons of machine tools. The main section, broadly classified as containing "chip-removing machines," took up more than half of the aggregate 405,420 sq ft of stands. Sheet-metal working, bending, and forming machinery occupied about a quarter of the remaining area, and abrasive machines nearly as much. In spite of its extent, however, the Exhibition could not wholly represent the great developments made in European machine-tool production since the war, as the responsible Committee applied certain restrictions, declining to accept for exhibition any metalworking machine that had been shown in previous 1954 exhibitions or fairs. While this bore a little hardly on visitors not attending these other exhibitions, it did insure that the Milan Exhibition contained a higher proportion of new tools and apparatus.

ASME Technical Digest

Substance in Brief of Papers presented at ASME Meetings



In-process surge stock pile is designed to handle coal from river barges, or direct by conveyer from an adjacent mine-cleaning plant or from railroad cars or trucks at a rate of 500 tons per hr. Coal is delivered by a 640-ft-long inclined conveyer to the top of the lowering well. This lowering well is a 120-ft-high × 6-ft-diam steel tube, supported on four legs so that the bottom opens directly over four hoppers, each equipped with a large vibrating feeder. Coal fed into the top forms a cone around the well by flowing out at one of several openings nearest the top of the forming pile. In this way loss by windage is minimized and a pile of 7500 tons is formed. Installation is at Mitchell Station of West Penn Power Company.

Materials Handling

Bulk-Materials Stock Piling, by Edward H. D. Gibbs, Heyl & Patterson, Inc., Pittsburgh, Pa. 1954 ASME Semi-Annual Meeting paper No. **54—SA-30** (multilithographed; available to April 1, 1955).

THE stock pile is an indispensable part of our major industries such as steel, aluminum, and power which are dependent upon large quantities of bulk materials. Stock piling of these materials is necessary to insure an uninterrupted flow of raw materials to continuously operating units such as coke ovens, blast furnaces, and power-generating stations. It is necessary because of the need for storage capacity between the source of the raw materials and the consuming unit which requires these materials. Stock piling is essential to absorb the differences between the rates of mining, transportation, and final use of coal, ore, bauxite, and other bulk raw materials. In this country, for example, we have many stock-piling problems caused by the economic necessity for using low-cost water transportation on the Great Lakes which is available only six or seven months out of each year.

The three generally accepted methods of stock piling and reclaiming bulk materials from stock piles are: Mobile units (caterpillar or tire-mounted); conveyer systems consisting of stackers and tunnel reclaiming belts under the stockpile; bridges spanning the stockpile. This paper deals primarily with the use of conveyers and bridges which are associated with permanent, large-capacity, or continuously operating systems.

The paper discusses the various means of handling bulk materials in and out of stock piles, together with their advantages and disadvantages. It points out some of the considerations which should enter into any determination of the best system in any particular instance.

In summarizing, the principal items to be considered are as follows: (1) The nature of the material to be handled, (2) the quantity to be stored and turnover rate, (3) the estimated life of the system, (4) the available storage space, and (5) the climate.

This paper discusses several typical large bulk-materials-handling systems and analyzes the reasons why they were chosen. They include a blast-furnace stockyard, an emergency coal stock pile, an "in-process" surge stock pile, a coke-oven coal-storage installation, and stock piling under cover.

Methods and Costs in Coal Storage With Scrapers and Bulldozers, by D. K. Heiple, LeTourneau-Westinghouse Company, Peoria, Ill. 1954 ASME Semi-Annual Meeting paper No. **54—SA-32** (multilithographed; available to April 1, 1955).

THIS paper is a brief survey of a bulk-materials-handling method—in this instance applied to coal. Applying the method to other materials than coal appears to be possible and economical although perhaps more limited. As in the case of coal, individual situations will require study and the equipment and proce-

dure should be selected and tailored to fit the conditions.

One of the principal advantages of bulldozer-scraper handling of coal in storage is increasing storage capacity in confined areas. This is done by more completely utilizing areas of irregular shape, by utilizing all of the available space without fixed trackage that must be maintained and kept clear, and by compacting the coal so that the available space (cubage) holds its maximum tonnage.

Second, a beneficial reduction of oxidation and the possibility of fires from spontaneous combustion also result from compacting when it is done in such a way as to make the pile impervious to air and water. Compacting is accomplished by the rolling and kneading action of big low-pressure tires so that voids are eliminated.

Some blending can be accomplished with bulldozer-scrapers to produce a more uniform fuel. Where areas are sufficiently large, incoming coal from different sources can be mingled by spreading it in exceptionally thin lifts so that the depth of cut during reclaiming picks up material from at least two sources. In smaller areas, where resulting layers of one coal are heavy, reclaiming downgrade across the face of the pile was said to be giving excellent mixing. The same method easily keeps open and working a small area, in the face of extremely low temperatures.

The lightness of bituminous coal as compared with most materials for which bulldozers are designed to work permits the use of sheet-metal extensions on the sides of the scraper. This increases capacity by as much as 50 to 100 per cent as compared with earth-moving work.

Flexibility of two basic machines was said to be great enough to fit into most coal-handling layouts. Examples are given to show the actual costs of handling operations with a single bulldozer scraper, an added bulldozer tractor with carrying scraper, and with a high-speed two-wheeled prime-mover-and-scraper combination for round-trip hauls averaging 1800 feet.

Equipment is usually set up to handle maximum tonnage requirements with a single-shift operation. This leaves overtime or additional shifts to assure a bunker-coal supply against equipment breakdowns or other unforeseen circumstances. Multiple units are used for the same reason, that breakdowns do not completely shut off coal recovery.

Bulldozer-scraper equipment is shown operating on top of coal-storage area

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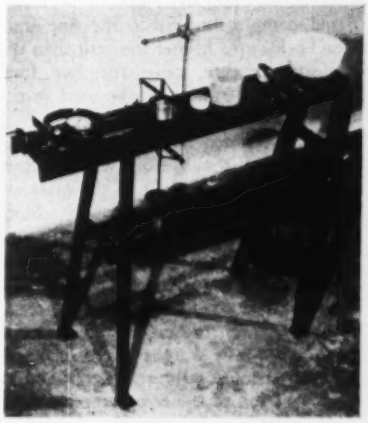
Flow of Solids in Bulk-Handling Systems, by A. W. Jenike, Mem. ASME, Consulting Engineer, Salt Lake City, Utah. 1954 ASME Semi-Annual Meeting paper No. 54—SA-34 (multilithographed; available to April 1, 1955).

THIS paper reports on the development of a quantitative method of design for flow of bulk solids in bins, hoppers, and spouts. The purpose of the paper is to show that a practical solution is in sight and that only a comparatively small effort is necessary to develop generalized design data in a form useful to industry. In order to put design for flow on a quantitative basis, the concept of the "flow factor" of a bulk solid has been introduced, and a method and apparatus



Shear-testing machine on which the flow factor is measured. The shear box is made of the fixed frame and the floating frame. A sample of the solid is placed in the shear box, covered with disk, and compacted by means of the load system ending with the compaction weight carrier.

to measure the flow factor have been developed. Based on the concept of the flow factor, a theory has been worked out leading to simple formulas governing the flow of bulk solids. The formulas contain coefficients whose values depend on the shape and size of the bin or hopper. These coefficients have yet to be established experimentally.

The importance of the problem was indicated by that fact that, in a trend toward automatic operation of handling, every link must be reliable. At present the only way to predict how a material will flow through a bin is a full-scale test, except where experience provides reliable guidance.

The flow factor of a material was defined as the ratio of peak compressive strength to unit weight of the material as a function of the ratio of compacting pressure to unit weight. Physically, the flow factor is the radius of the largest circle over which the compacted material can form a stable dome.

Flow factors are measured on a special transverse shear-testing machine on which samples of the material in a round shear box may be compacted to any desired degree and for any length of time. The shearing load is applied by means of a proving-ring system. The deflection of the ring, shown by a dial indicator, is read at the point of rupture and gives the maximum shearing stress. The test is repeated for different values of test pressure.

Composition of the sample was found to be important with materials of a wide range of particle size because under field

conditions segregation cannot be eliminated completely. Since the fine fraction builds up a higher strength than the uniform mixture, only the fine fraction of the material can be used in the test.

It was pointed out that a loose bulk solid flows through a bin when stresses produced by the weight of the mass exceed the strength of the solid. Since compacting pressure contributes to this strength, it is advantageous to keep it low and to operate with materials having stable surface conditions.

Compacting pressure is built up in three ways: By weight of the material, by the impact of falling particles, and by the vibration of the structure. Solidity of the mass may be caused by changes on the surface of the particles such as moisture content.

Two classes of bulk solids were recognized: Fine and flaky materials, which pack and build up high strength per unit weight under pressure but flow readily when aerated; and nonaerated materials which are subject to impact pressure and therefore cancel whatever advantage there might be in the low static pressure of steep-walled hoppers.

In spouts and chutes, where static pressure is low, compaction results from either impact or vibrational pressure and can be prevented by designing to prevent the material from being brought to an abrupt halt within the spout or chute.

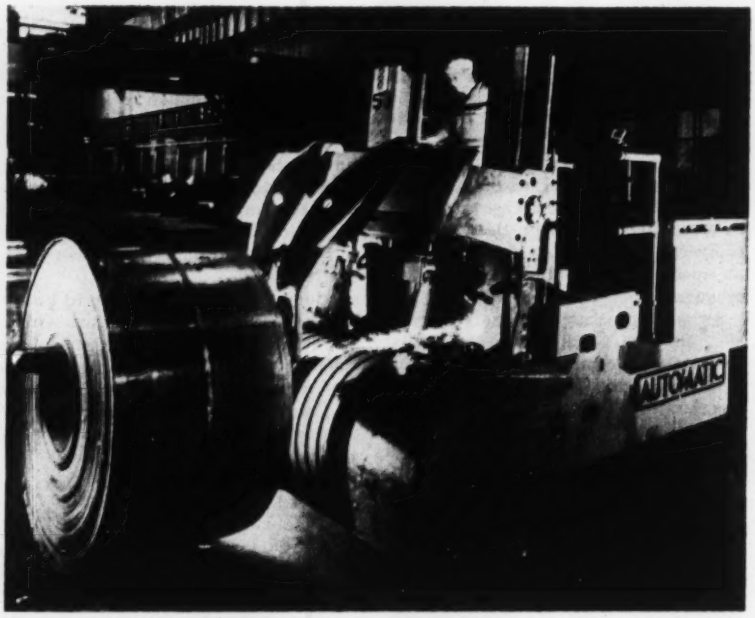
Use of Heavy Trucks in Industry, by F. W. Lamb, Automatic Transportation Company, Chicago, Ill. 1954 ASME Semi-Annual Meeting paper No. 54—SA-31 (multilithographed; available to April 1, 1955).

A DESCRIPTION is given of the general nature, type, and uses of heavy industrial trucks, defined as those whose capacities are 10,000 lb and more. Three types—fork and ram trucks, die-handling trucks, and towing tractors—are found to be used primarily in steel-mill operations and stamping-plant work.

How these trucks perform, the natures of the loads they handle, and how their operations relate to the entire production processes are covered.

Industrial trucks are generally more versatile than cranes. The latter, operating on the same overhead rail runway, are not able to pass one another in operation.

This may cause certain complications if, for example, one crane breaks down, causing a tie-up of the other cranes on the same runway.



A typical use of heavy industrial trucks is shown at the Jones & Laughlin strip mill in Pittsburgh. A huge steel coil is removed from a conveyer belt for transfer on the ram of the truck to another operating area. The ram truck has a single fork placed in the center of the front of the truck to pick up and carry coils. Operated by one person, the ram is moved into the center of the coil, the carriage on which the ram is mounted is raised, and the truck moves away to deposit its load elsewhere.

On the other hand, trucks are flexible, are able to operate practically anywhere in the plant, and substitutions can easily be made should one be out of service for maintenance.

In the operation of a mill, or any manufacturing plant, it is almost axiomatic to say that its production must be maintained continuously if maximum profits are to be achieved.

Immediate availability of trucks to service various operations in the mill provides greater assurance that operations will be maintained despite crane breakdowns and the like.

Another aspect is that cranes are restricted in movement from plant to plant, where the buildings are either at right angles or parallel to one another.

Although heavy trucks do require well-supported floors, it has been found that ample support usually exists by virtue of floor capacities required to support heavy machinery. On the other hand, to install larger cranes may possibly mean the addition of reinforced structural elements to support heavier overhead weight.

It also has been found that the cost of industrial trucks may be paid by the savings resulting from avoiding the extra expense of reinforced overhead structures.

Shall It Be a Crane, a Conveyer, or an Industrial Truck? by A. T. Gaudreau, Mem. ASME, Gaudreau, Rimbach & Associates, Pittsburgh, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-33 (multilithographed; available to April 1, 1955).

THE major factors to be considered in attempting to choose the best device to solve a particular handling problem generally fall into two principal groups: (*a*) Mechanical requirements, and (*b*) economic appraisal. Usually developed separately, although considered jointly, these two groups of factors seldom fail to provide a dependable criterion for judging the suitability of a piece of handling equipment. This measure not only guards against the selection of improper equipment but frequently suggests the particular type of device which will do the job best from a mechanical as well as from an economic standpoint.

The component factors making up each of these two groups include the following:

Mechanical requirements: description of material handled, volume handled per year, travel speeds, carrier trips, distances traveled, and lifting operations; economic appraisal: equipment workloads, number of men required, annual cost of labor, annual cost of fuel, maintenance, and depreciation, capital

investment required, and time required for investment to pay for itself.

It is only through the analysis of these or similar factors at each material-handling point that the various selections of different types of equipment can be fitted into an over-all flow of material on an integrated plantwide basis. Even in a one-product plant, such as a newsprint paper mill, several types of successive handling problems are encountered after the finished product comes out in the form of a newsprint roll which retains its form and characteristics throughout all handling operations beyond that point. These successive handling problems include: (1) Shipping from paper mill to storage warehouses on the plant premises; (2) transporting between buildings; (3) receiving and stacking in warehouses; (4) detiering and shipping from warehouses; (5) overside loading into ships' holds; and (6) stowing cargo inside ships' holds.

Along this particular line of flow, different types of handling equipment are found most desirable at different points even though the same material unit, the newsprint roll in this case, is being handled throughout all the six stages involved.

As gaged by their respective sales volume a year, cranes, conveyers, and industrial trucks rank as the three largest groups of material-handling equipment in use today. The remaining groups consist mainly of lifts and hoists, monorail systems, pneumatic systems, tractors and trailers, rail cars, stackers, and miscellaneous storage facilities and process-handling accessories.

Cranes, conveyers, and industrial trucks can all lift and transport material up to 45 tons per load which is the present limit of a powered industrial truck. Cranes and conveyers can, of course, go much higher than this figure. This eliminates the weight factor as having much bearing in selecting between these devices.

Cranes and conveyers transport material along fixed paths only, whereas industrial trucks are self-propelled units which are free to travel in any direction at will. But the economical traveling distance is longer for conveyers than for trucks, and longer for the latter than for cranes. The travel speed is generally faster for trucks than for cranes, and faster for cranes than for conveyers. In general, cranes cost more than trucks, and trucks more than conveyers, for the corresponding amount of two-way tonmiles of work performed.

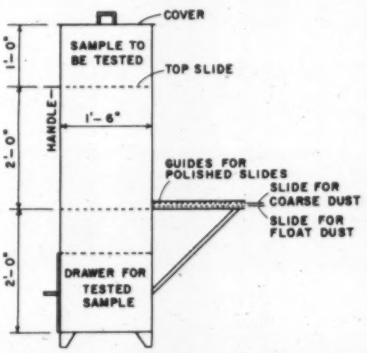
The methods of handling raw materials, work in process, and finished products in a plant vary almost as much as the processing operations they serve. Distillation operations require tanks, pumps, and pipe line for handling materials. Machining operations in metalworking plants require endless types of cranes, conveyers, and industrial trucks.

Fuels Technology

Handling and Dustiness Characteristics of Fine Coal, by H. L. Washburn, Pittsburgh Consolidation Coal Company, Library, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-72 (multilithographed; available to April 1, 1955).

THE handling characteristics of fine coals are becoming increasingly important to consumers. The dust evolved by some fine coals during movement on belts, through transfer points, and into bins can have such a high nuisance value that the coal will be rejected for power-plant use. The heart of the matter is moisture content. At some relatively high moisture content the coal will cease to be handleable and at some relatively low moisture content the coal will be very dusty.

In conjunction with development work on coal pipe-line transportation systems carried out by the research and development division of Pittsburgh Consolidation Coal Company, a series of tests were made to determine the handling and dustiness characteristics of several fine coals, with particular emphasis on defining the optimum moisture content for each coal, and developing a means of predicting the optimum moisture content for any other coal.



Test cabinet of The American Society for Testing Materials used for testing dustiness of coal and coke. A 50-lb air-dried sample is placed in the top compartment of the cabinet. The upper slide is withdrawn allowing sample to drop into the bottom drawer. Five seconds later both coarse and float-dust slides are quickly inserted. The coarse-dust slide is then withdrawn for examination and later the float-dust slide is withdrawn.

From the results of tests on fine coals reported it can be concluded that there is a moisture content for each coal (depending on the size consist) at which that coal will be handleable in standard utility-station equipment and will not be objectionably dusty in the same equipment. The results of the bin test, small-scale tests, and confirming full-scale tests indicate that the angle of slide test and the dustiness index test are adequate to predict this optimum moisture.

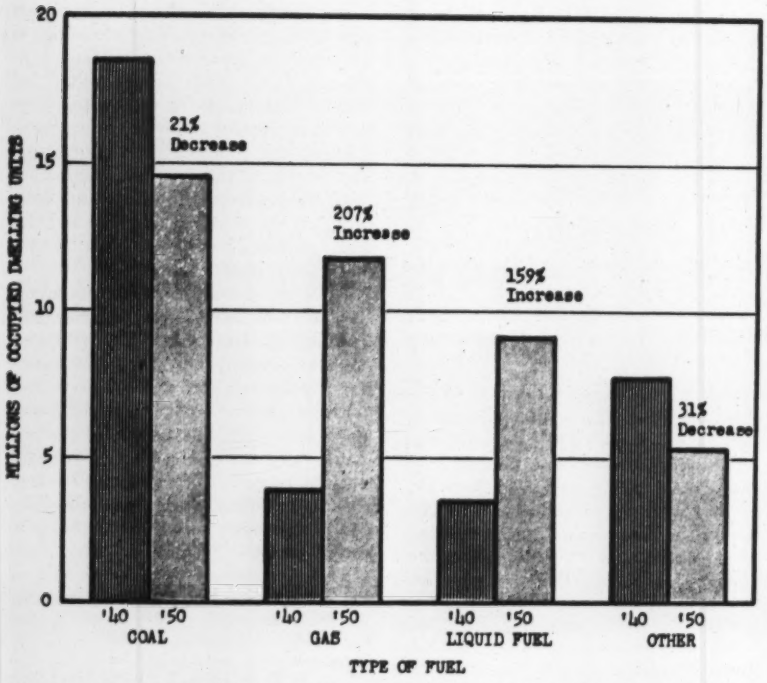
The angle of slide is by no means a precise, or all-inclusive, measure of fine-coal handling characteristics. The results of the test are merely indicators of the handling characteristics of a coal at a particular moisture content. In contrast, the dustiness test is a reliable measure of the potential dustiness of a given coal at some moisture content. The results of the test are only as difficult to apply as it is difficult to determine what is dusty coal at a power station.

Trends in Production and Use of Natural Gas, by F. B. Jones, Equitable Gas Company, Pittsburgh, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-71 (multilithographed; available to April 1, 1955).

DURING the past decade the relationships of the annual supply of the mineral fuels have been rapidly changing. In general, the proportion of the total energy supplied by solid fuels has been decreasing and the proportions supplied by liquid and gaseous fuels have been increasing. During the decade 1943–1953 the increase in energy furnished by natural gas was larger, percentagewise, than that of the other mineral fuels. The record is impressive, particularly since most of this progress was made after World War II ended. Certainly the investing public has responded actively to the opportunities for investment offered by the natural-gas industry during this period. It is the investing public that has made it possible for the natural-gas industry to obtain the necessary tools and equipment to meet the consumer demand for this phenomenal product, prepared by nature ready for use.

After the end of World War II there were many factors, of both a technical and economic nature, that contributed to the tremendous growth of this giant industry. In fact, the stage was set for the boom expansion of the natural-gas industry even before World War II ended

Some of the principal factors that were operating to bring about this growth were: (1) Know-how in pipe-line construction and operation, (2) expanding



Comparison of heating fuel for occupied dwelling units in the United States during the years 1940–1950

natural-gas reserves, (3) the development and growth of underground storage of natural gas, and (4) the favorable cost of natural gas as compared with costs of other fuels, particularly for space-heating purposes.

During the war years all mineral fuels were in strong demand and the supplies were limited for different reasons applicable to each type of fuel. After the war the "unregulated" fuels, such as oil and coal, were permitted to rise. On the other hand, the use and price of natural gas, particularly in those markets that were served by the public-utility and pipeline systems, were subject to various types of governmental regulations. Consequently, the average retail price of natural gas did not rise materially during the war years or during the years immediately following the war.

Today natural gas is the preferred mineral fuel in most areas, but its supply is still insufficient to meet the demand because of two factors: (1) The favorable competitive-price position of natural gas; (2) and the inherent form values, such as cleanliness, ease of handling, etc., which make it a more desirable fuel for many uses, particularly for space heating.

In order to understand natural-gas growth trends, an understanding of the operating and use characteristics of each major segment of the market is necessary. First, substantial volumes of natural gas are used in the field for production purposes and also for raw material in the production of chemicals. Such uses of gas are subject to control by contract, and the physical conditions under which the gas is required can be specified in such contracts.

The second large use of natural gas is for the production of steam or power in large quantities. Such uses are usually sold under special service contracts that carry "interruptible clauses." The purchasers of such services are required to provide stand-by fuels which can be substituted quickly for the natural gas when it is needed to supply the residential or commercial markets.

The third large market for natural gas includes the commercial and industrial users of "firm gas service" who prefer gas for economic and/or technological reasons. The demands for gas by these users are related to over-all industrial production and have grown substantially since the war. Barring sharp fluctuations in the level of business activity, the "firm" industrial or commercial user creates a steady year-round demand for natural gas which is a desirable type of load for a pipe-line or natural-gas distributing utility.

Principal remaining market for natural gas today is for residential purposes where gas is used primarily for cooking, water-heating, and space-heating purposes. This is the segment of the total market for natural gas which has increased rapidly during the past decade. Further, it is the segment about which most of the gas industry's present opportunities and problems revolve. This is the case because the space-heating load has already grown tremendously since the war and promises to become even larger. Furthermore, the consumption of any fuel for this purpose is closely related to the degree days on a daily, monthly, and annual basis. In this market convenience and cleanliness factors have a strong influence on the value of natural gas.

Production Engineering

Production-Engineering Curricula, Content, and Intent, by O. W. Boston, Fellow ASME, University of Michigan, Ann Arbor, Mich. 1954 ASME Semi-Annual Meeting paper No. 54—SA-8 (multilithographed; available to April 1, 1955).

PRODUCTION engineering may be considered as limited to (*a*) production (any quantity) not including sales and distribution; (*b*) mechanical processes, not chemical, mining, or construction, as these are highly specialized (however, certain procedures of the mechanical processes are basic and well adapted to these latter fields); (*c*) redesign of product for economical production but not for strength or function.

The courses in production engineering at the University of Michigan are the result of the past 30 years' development, beginning with shop courses, with the idea of co-ordinating product design, metallurgy, and production. As an exception to the general rule, this work has been carried on outside the mechanical-engineering department.

In the spring of 1951 a complete curriculum in production engineering was presented to the authorities for approval. At the same time a revised curriculum of the mechanical-industrial course was prepared. The proposed mechanical-industrial and production-engineering curricula were integrated into one, known as industrial engineering. Two options were provided, management and production. These two options follow a common program for the first two years but then begin to differ in order to provide courses for proper sequence in later work.

The production-engineering option of the industrial-engineering curriculum is intended to meet the needs of those students primarily interested in the methods and operations of manufacture. It in-

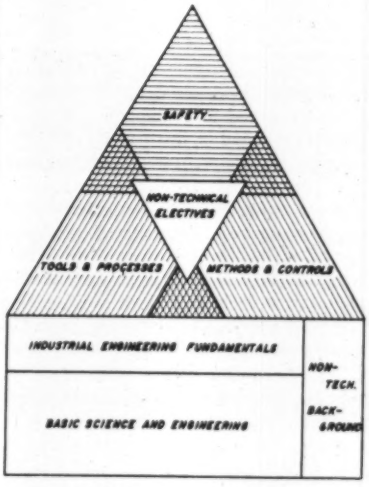
cludes the development, operation, and control of processes, such as casting, forging, rolling, die-casting, stamping, molding, and machining. It is concerned with such functions as design for production, parts routing and equipment layout, and methods of manufacture; with jig, fixture, gages, tool, machine-tool and die design; and with technical estimating and inspection. The objective is to acquaint the student with principles and methods of fabricating materials.

Design for production, processing of parts, selection and design of machines, and cost estimating are promising fields, with supervision and management as likely goals. The welding, foundry, stamping, forging, and plastic industries, and the tool-and-die shops, parts-manufacturing shops, and those making instruments for measuring and inspection offer a limitless field for scientists and production engineers.

Production Engineering—An Engineering Education, by I. L. Reis, Assoc. Mem. ASME, and K. J. Trigger, Mem. ASME, University of Illinois, Urbana, Ill. 1954 ASME Semi-Annual Meeting paper No. 54—SA-15 (multilithographed; available to April 1, 1955).

This paper presents a philosophy of engineering education with particular reference to production engineering. Methods and goals are examined and differences among various curricula discussed. Illustrations using the curriculum of the University of Illinois are given.

The University of Illinois curriculum offers a combination of basic engineering with some opportunity for specialization in one or more areas of emphasis.



The Foundation and interrelationships of curriculum areas within the industrial-engineering program at the University of Illinois

The basic-science and engineering-fundamentals group is a major element in any student's program. This includes chemistry, physics, analytic geometry, calculus, statistics, engineering drawing, statics, dynamics, thermodynamics, resistance of materials, materials processing, physical metallurgy, electrical circuits and equipment, and a three-course sequence in machine design.

"Industrial engineering fundamentals" is the term used to embrace these courses which form the background of knowledge upon which advanced or specialized work may be built. Manufacturing methods and processing, manufacturing organization and operation, methods-time analysis, cost accounting, and economics form the backbone of this group as offered by the University.

With the foregoing groups of subject matter as a background, additional work must be taken in a special area of emphasis in industrial or production engineering as well as in nontechnical areas. Safety, tools, and processes, and methods and controls are the three stems of emphasis. However, each of these areas overlaps the other two, so that no matter which one is chosen, the others are not entirely neglected. Courses common to all are process planning and tool design, safety engineering, and plant layout and materials handling.

According to the paper, the successful teaching of engineering depends upon several factors:

A competent faculty, properly motivated to do a good job in the classroom and encouraged to develop in areas of special interest.

A well-planned curriculum, taking advantage of the strengths of the faculty and geared to the real needs and desires of industry.

Adequate physical facilities with which to carry on the work.

Careful attention to modern developments, new trends, and changing needs.

The proof of how well these things function, of how well the job is done, is in the performance of those graduating from an engineering curriculum.

Interaction of Friction and Temperature at the Chip-Tool Interface in Metal Machining, by F. F. Ling, Assoc. Mem. ASME, and Edward Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-2 (in type; available to April 1, 1955; to be published in Trans. ASME).

The significance of chip-tool interface friction-temperature characteristics in metal machining is pointed out.

For orthogonal metal machining with Type 2 chip, an approximate analysis of the interface temperature, or cutting temperature, is given for linear friction-temperature characteristics and small rake angles. In the analysis the coefficient of friction and the temperature are expressed in terms of the cutting velocity, the physical properties of the material, and constants obtained from the data of Chao and Trigger.

Metals Engineering

The Punching of Medium-Carbon Steel, by S. K. Clark, Case Institute of Technology, Cleveland, Ohio. 1954 ASME Semi-Annual Meeting paper No. 54—SA-35 (mimeographed; available to April 1, 1955).

One of the most commonly used industrial processes, and one which has received little attention from the standpoint of metal flow and fracture, is that of punching, that is, of driving a flat-headed circular punch through a sheet or strip of metal.

An interesting application of the punching process is to be found in the silent-chain-manufacturing industry, where an immense number of chain links are produced daily in which the apertures or holes through which the pins pass, are punched.

The primary fault in so far as the quality of the finished product is concerned, is that the hole which is punched in order to receive the pin is not smooth and uniform but often rough and tapered, so that after heat-treatment the small hardened projections inside the hole must be worn off before a smooth bearing surface is obtained over the full width of the link. This causes a newly installed chain to wear considerably more in its first few hours of operation than at any equal time interval throughout its life. Even more serious, when the link is heated and then quenched the small rough projections on the inside of the hole cool quickly, giving them a high hardness value. It is thus often possible for these hardened rough spots to score the chain pins, causing a considerable reduction in over-all chain life.

For these reasons chain manufacturers long have been interested in obtaining a more thorough understanding of the punching process and attempting to apply it to produce better punched chain-link apertures. This paper reports some of the results of a preliminary program begun by the author, under the sponsorship of the Morse Chain Company, to gain experimental data on the process.

Experimental results of tests relating the primary variables in the punching of steel strip are presented and are discussed and correlated with the known physical properties of the material used. Thermal effects are proposed as an explanation of some of the phenomena observed, and an attempt is made to use quantitative measurements of fracture to modify the theory further.

Metal Processing

The Grinding of Titanium Alloys, by C. T. Yang and M. C. Shaw, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1954 ASME Semi-Annual Meeting paper No. 54—SA-57 (multilithographed; available to April 1, 1955; to be published in Trans. ASME).

When titanium is ground under conventional conditions, the rate of wheel wear is abnormally high and the finish produced is poor. Improvement in surface finish accompanies a decrease in wheel-wear rate.

A study of the influence of a wide variety of operating and grinding-wheel variables reveals the most important quantities to be grinding-wheel speed, type of abrasive, and grinding fluid. When a wheel speed of 1500 to 2000 fpm is used with a suitable fluid and a white aluminum-oxide wheel of conventional hardness, grain size, and bonding, greatly improved results are obtained.

All of the observations that have been made can be explained in terms of the assumption that bonding between titanium chips and abrasive grains is of major importance.

While most of the experiments and discussion are centered around the surface-grinding operation, cylindrical grinding and the cutoff operations are also considered in this paper.

Rubber and Plastics

Dielectric Breakdown Properties of Thermosetting Laminates, by N. A. Skow, Synthane Corporation, Oaks, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-67 (multilithographed; available to April 1, 1955).

Thermosetting laminated plastics are used extensively for electrical insulation because of their unusual combination of electrical, mechanical, and chemical properties. Excellent electrical insulators, these materials are also mechanically strong, light in weight, and easy to fabricate. They resist chemical corrosion, moisture, aging, heat, and temperature deterioration.

To establish safe operating loads, tests for the endurance limits of dielectric strength were run on each of several grades of thermosetting plastic laminates plotting voltages against time. The data thus obtained indicate that for a given thickness and atmospheric condition, a maximum voltage exists below which failure will not occur. Tests of this type yield results which are valuable to the design engineer in determining the proper grade and thickness of material for use as insulating parts in electrical equipment.

Conclusions drawn from these tests would indicate that for selecting thermosetting plastic laminates to be used as a dielectric medium, it is important to know the temperature at which the equipment is to be operated, the atmospheric conditions to be encountered, the mechanical strain, and the dielectric stress to be applied.

If the equipment is used under dry conditions and the mechanical-strength requirements are not severe, paper-base laminates are very satisfactory. If humid conditions are factors it would be advisable to use the more water-resistant paper-base grades such as Grade XXXP.

Under dry conditions requiring high mechanical strength it may be necessary to use a fabric grade such as LE. Under continuous humid conditions requiring high mechanical strength it may be necessary to use Grade N-1. If arc resistance is an important requirement, Grade G-5 is indicated.

Steam Power Generation

Economic Comparison of River and Cooling-Tower Circulating-Water Systems, by J. Lichtenstein, Mem. ASME, and B. C. Sprague, Mem. ASME, Santa Fe Tank & Tower Company, Los Angeles, Calif. 1954 ASME Semi-Annual Meeting paper No. 54—SA-37 (multilithographed; available to April 1, 1955).

The ratio of heat rejected to the condenser to the total heat entering the turbine has been steadily declining for steam-electric power plants. As a result, not only has the relative cost of the equipment necessary for the heat rejection been reduced but the economics of the power-plant location has been affected. In the economic balance which determines the power-plant location, the relative importance of locating the plant along rivers, lakes, or other large bodies of water has been diminished.

With cooling towers now available, the question of the economics of a river location versus the employment of a cooling tower is an important one.

To compare the two systems, it is first necessary to reduce them to a common economic basis. Of all the possible combinations included by the two systems, those of minimum total costs must first be found. The total costs include costs of equipment, capitalized costs of power requirements, and capitalized cost of system-capability losses.

A mathematical method is described and the derived equations given which permit the calculation of the economic specifications on which are based calculations resulting in the selection of equipment of minimum total costs.

The comparison between cooling-tower and river plants shows that there is a cost differential between them. At a specified location, all other conditions being equal, the cost differential favors the river plant. However, the freedom of choice of location which the cooling-tower plant permits, offers possibilities of savings which in most cases will equal, and in many cases, surpass this cost differential. Under any circumstances the answer to the question of river versus cooling-tower plant can be given only as the result of an economic study of the problem.

Air-Preheater Size Selection to Improve Over-All Steam Power-Plant Efficiency, by B. C. Mallory, Fellow ASME, and W. F. Allen, Jr., Assoc. Mem. ASME, Stone & Webster Engineering Corp., Boston, Mass. 1954 ASME Semi-Annual Meeting paper No. 54—SA-62 (multilithographed; available to April 1, 1955).

In order to select the optimum size of preheater and obtain improved steam-generator efficiency by reduction of exit flue-gas temperature, it is preferable to analyze the performance of various preheater sizes under expected operating conditions over a range of loads and air temperatures instead of accepting complete steam-generator design including preheater-performance data on the basis of full load and 80 F ambient air. The studies presented in this paper for rotary regenerative air-preheater size selection have been carried out for a range of loads and air temperatures. They are based on a fixed steam-generator design with the exception of the preheater and with fixed flue-gas flow and temperature to the preheater at each load.

Studies were made to improve the over-all efficiency of 66-mw and 100-mw steam electric-generating plants by selection of the optimum rotary regenerative air-preheater size and method of protection.

The studies show that heating of combustion air by extraction steam from the turbine is an economically sound method of improving over-all power-plant efficiency, as well as providing a flexible

corrosion-protection system for the air preheater.

It is recognized in these studies that preheater cold-end metal temperature must be maintained at a high enough value to minimize corrosion and plugging of the air preheater and, consequently, minimum allowable flue-gas exit temperature is a function of air temperature to the preheater. Air by-pass, hot-air recirculation, and steam-air heating are considered as means of maintaining cold-end metal temperature.

It is shown that steam-air heating by extraction steam may result in a twofold gain, compared with supplying ambient air to the preheater: (*a*) An improvement in the thermal cycle due to the generation of additional by-product power, and (*b*) a decrease in dry-gas loss due to the permissible lower flue-gas exit temperature.

The studies indicate that the total gain made possible by steam-air heating with oil or high-sulphur coal fuel may exceed two per cent in over-all plant efficiency compared with supplying ambient air to the preheater.

One of the two plants studied consisted of a 625,000-lb per hr steam generator burning either oil or coal, and a 66-mw Preferred Standard turbine generator with steam conditions of 1250 psi, 950 F, and five stages of feedwater heating. The other consisted of a 750,000-lb per hr reheat steam generator burning either oil or coal and a 100-mw Preferred Standard turbine generator with steam conditions of 1450 psi, 1000 F/1000 F reheat, and five stages of feedwater heating.

Design of Steam-Piping Systems for Large Central-Station Applications, by R. L. Jackson, Mem. ASME, and L. H. Johnson, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1954 ASME Semi-Annual Meeting paper No. 54—SA-69 (multilithographed; available to April 1, 1955).

One of the principal jobs facing the designer of large central stations for power generation is the layout of the steam-piping systems. The importance of this job has increased manyfold in the past few years and indications are that it will continue to do so.

Today, with average temperatures 1000 F and higher, pressures of 1450, 1800, and 2000 psi, and the very large ratings used, steam pipes have become heavy-walled, expensive items.

The general use of the reheat cycle means a large increase in the number of pipes connecting the boiler and the turbine. The combined effect of the expansion forces and moments of all the pipes on the end points becomes a limiting factor. This is particularly true of the turbine where alignment must be maintained within very close limits.

These factors, along with the need to keep costs at a minimum and reliability at a maximum, make it essential to do a thorough accurate analysis of piping-system flexibility.

This paper points out the need for more complete and accurate flexibility calculations on power-piping systems.

A method is described whereby a reliable analysis can be made on a production-line basis that will produce more efficient designs, resulting in good possibilities for savings in initial costs. Attention also is called to the necessity of actual field checks of movements on installations to verify that the systems perform as expected.

Analysis of Pipe Systems With Special Expansion Features, by J. E. Donahue, Assoc. Mem. ASME, Westinghouse Electric Corporation, Philadelphia, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-70 (multilithographed; available to April 1, 1955).

This paper deals with devices for absorbing movements in a system. More specifically, the devices resemble either a circular flat-plate bellows-type expansion joint or a toroid-type expansion joint with or without tie rods to carry the hydrostatic end thrusts. The system resembles a pipe with thermal movements to be absorbed.

A method for calculating the stresses in the parts resulting from axial displacement, rotation, and pressure is presented.

In addition, the paper presents a method for determining the in-plane and the out-of-plane spring constants for the devices. Thus the devices can be converted into an equivalent length of straight pipe. This equivalent length can be incorporated into any standard mathematical flexibility analysis for a piping system, and the total net end reactions and stresses in the system evaluated.

Nuclear-Power-Plant Design

Comparative Performance of Turbine-Generator Units in Saturated-Steam Cycles, by N. A. Beldecos, Mem. ASME, and A. K. Smith, Westinghouse Electric Corp., Chester, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-65 (multilithographed; available to April 1, 1955).

In atomic power plants the physical properties of some of the nuclear-reactor structural materials and coolant media impose serious limitations on the steam-generator-outlet temperature resulting in turbine-throttle conditions radically different from present-day practice. At first glance, the utilization of saturated-steam turbine cycles appears as a complete reversal of the years of development which have extended operating conditions to supercritical pressures and temperatures. The substitution of a nuclear reactor as the heat source in a power plant introduces radical changes in the fuel and capital-cost picture. Since the plant efficiency requires economic justification, it is not possible to exclude saturated-steam cycles from consideration.

This paper extends performance data for central-station turbine-generator units into the region of saturated steam where few or no data are available for large unit ratings. A performance level and trend is established which is representative of that which can be anticipated with present-day turbine practice.

The paper confines the turbine-generator performance to units of 100 mw capability or greater to coincide with the trend in unit ratings for central-station application. The performance data are supplemented by a brief review of turbine-design considerations.

In the region of saturated steam, some method of moisture reduction is required. The various schemes are reviewed and a comparison made to establish the relative merits of the moisture separator and steam reheater.

The paper further illustrates the relative effect of the principal cycle parameters thus making possible the evaluation of the saturated-steam cycle.

This paper is intended for integration with other investigations which are being made to evaluate properly the application of atomic energy to central-station power generation.

Working-Stress Criteria for Nuclear-Power Plants, by B. F. Langer, Mem. ASME, Westinghouse Electric Corporation, Pittsburgh, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-59 (multilithographed; available to April 1, 1955).

There are two respects in which strength calculations for nuclear-power-plant components may differ from calculations made for conventional heat-power or process equipment. One is the greater importance of thermal stresses due to the generation of heat inside the material of the structure. The other is the frequent use of unfamiliar materials.

In this paper a method is proposed for combining the stresses produced by fluid pressure with those produced by thermal

gradients in order to arrive at a practical estimate of the factor of safety in a structure such as a pressure vessel. Because of the relaxation of thermal stress it is possible to show that certain operating conditions are really safe even though a simple addition of pressure stress and thermal stress gives too high a value.

A discussion is given of the relative importance in reactor design of such physical properties as ductility, creep, endurance limit, creep-rupture strength, impact strength, and notch sensitivity.

The Thermal Design of Nuclear-Power Reactors, by N. J. Palladino, Mem. ASME, Westinghouse Electric Corp., East Pittsburgh, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-58 (multilithographed; available to April 1, 1955).

THIS paper presents the development of relationships between maximum fuel-element surface temperatures, coolant-temperature rise, flow, pumping power, and operating steam temperatures for use in the design of a power-producing nuclear reactor.

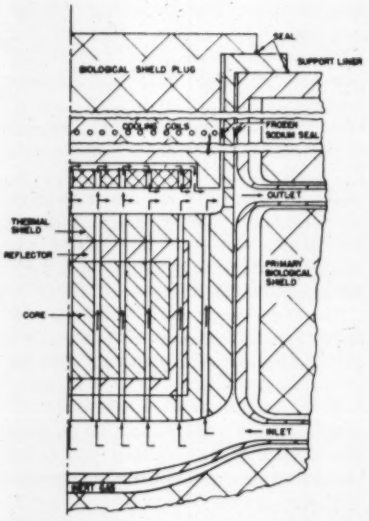
The heat output of a power-producing reactor is generally limited by the maximum metal-surface temperature which can be utilized without incurring excessive corrosion or dangerous conditions of boiling. The design of a reactor on the basis of maximum metal-surface temperature is particularly important in view of the fact that heat is not generated uniformly throughout the reactor and because of the fact that tolerances which must be established for manufacturing purposes may lead to further increases in hot-spot temperatures.

Structural Problems of a Sodium-Cooled Nuclear Reactor, by D. R. Miller and W. E. Cooper, Assoc. Mem. ASME, Knolls Atomic Power Laboratory, General Electric Co., Schenectady, N. Y. 1954 ASME Semi-Annual Meeting paper 54—SA-75 (multilithographed; available to April 1, 1955).

PROGRESS is being made in the solution of problems in the use of sodium as the coolant in nuclear reactors, according to this paper. The paper discusses some of the design problems of a reactor in which the temperature of the sodium would vary between 600 and 850 F normally. These temperatures would allow a satisfactory thermal efficiency in the power plant and leave a margin for somewhat higher local temperatures without undue loss of structural strength and ductility.

Sodium has advantages as a coolant primarily because of its high heat-transfer coefficient, several times that of water, and its high boiling point, 1621 F at atmospheric pressure. It has the additional advantage that its high electrical conductivity, about 20 per cent that of copper, allows efficient pumping with electromagnetic pumps, thus permitting elimination of shaft seals or canned rotor motors. Because of the high heat-transfer coefficients, the temperature rise from the main coolant stream to the fuel-element surface is small, even with high heat-flux densities.

One of the principal difficulties in the reactor design arises from the fact that major loadings are thermally induced, which is rare in other power systems. Sodium's high heat-transfer coefficients increase thermal transient stresses in structures in contact with the coolant, since the metal surfaces closely follow the transient temperatures of the sodium. This makes fast temperature transients much more significant with sodium than with water, vapors, or gases.

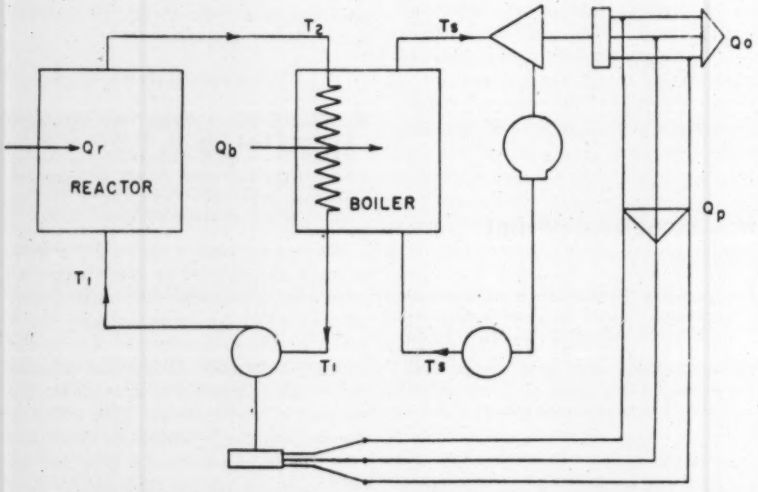


Schematic diagram of a sodium-cooled nuclear reactor for power generation. The power unit might be installed in the reactor container as an assembly consisting of the support liner, reactor core, reflector, thermal shield, and shield plug.

Another disadvantage of sodium is that electric heaters must be provided to keep the coolant fluid during filling and shutdown. Also, sodium becomes highly radioactive and must be contained within a biological shield. Furthermore, to guard against the sodium-water reaction hazard, the system would use multiple barriers between sodium and water, and the intervening spaces would be monitored for leak detection.

In spite of these limitations, extensive experience gained in other types of installations shows that systems utilizing sodium can be made reliable in operation, and with appropriate safety precautions the hazards are no greater than those in many other common industrial systems. The general plan is to assure adequate structural design strength through establishment of conservative stress limits, the recognition of all significant problems, close attention to design details, extensive theoretical and experimental stress analysis, close co-operation among designers, analysts, metallurgists, and manufacturing personnel, and the resolution of borderline cases individually after consideration of all factors, including schedules and consequences of mechanical failures.

The authors are not satisfied with present design bases for stress limitation but are striving for improvement which must be accompanied by increased knowl-



Line diagram of nuclear-power plant designed for electric-power production

edge in the fields of metallurgy and stress analysis. The fatigue behavior of metals subjected to strain cycling is being studied further under severe conditions, for example. Further fundamental investigation, theoretical and experimental, of many additional problems is necessary. The aim of improved design bases is to provide more definite safety factors and a minimum of restraint on design because of ignorance of stresses and their effects on structures.

Gas-Turbine Power

A Study of Flame Stability Based on Reaction-Rate Theory, by E. A. DeZubay, Westinghouse Research Laboratories, East Pittsburgh, Pa. 1954 ASME Semi-Annual Meeting paper No. 54—SA-27 (multilithographed; available to April 1, 1955).

THE ability of a flame to exist in the sheltered wake of a nonstreamlined body at very high fuel-air mixture stream velocities has long been known. The relatively recent development of turbojet and ramjet engines has focused attention on this phenomenon as a possible type of burner.

In the following studies the geometry and flow conditions were made as simple as possible. Essentially, the effect of fuel, size, velocity, pressure, and fuel-air ratio on the flame-stabilizing ability of a nonstreamlined body were to be studied, since these variables are the most important to the designers of practical combustion equipment. A circular disk perpendicular to the axis of, and concentric with, a circular duct was chosen as simplest geometric configuration of a flame-holding system. The fuel-air mixture supplied to the duct was thoroughly mixed and homogeneous, and the velocity profile of the mixture stream entering the duct was flat. The range of variables tested is summarized in the following table:

Fuel	Propane	Hydrogen
Disk diam, in.	1/4, 1/2, 1, 1 1/2, 2	1/8, 1/4, 1/2
Duct diam, in.	1.32 and 2.75 ID	1.32
Pressure, psia	3 to 15	2 to 6
Velocity max, fps	600	875
Temp, deg R	550 ± 30°R	550 ± 30°R
Humidity	0.006 ± 0.002 lb water/lb dry air	0.006 ± 0.0015 lb water/lb dry air

The fuels used in the experiments were a commercial grade of propane containing a minimum of 95 per cent propane and no unsaturated hydrocarbons, and hydrogen of 99.7 per cent purity.

The blowout points for propane air mixtures of disk sizes from 1/4 to 2 in. in a 2.75 in. duct are presented in left diagram. On this curve the fuel-air ratio correlates with the independent variables of velocity, pressure, and size in the form of

$$\frac{W_f}{W_a} = f\left(\frac{V_D}{P_D^{0.95}\, D^{0.85}}\right)$$

where

$\frac{W_f}{W_a}$ = fuel-air ratio at blowout

V_D = velocity through annular area formed by test duct and disk, fps

P_D = pressure in plane of disk, psia

D = disk diameter, in.

The blowout or stability points for hydrogen-air mixtures of disk sizes of 1/8, 1/4, and 1/2 in. in a 1.32 in. duct are presented in right diagram. On this curve the dimensionless fuel-air ratio correlates with the independent variables of velocity, pressure, and size in the form of

$$\frac{W_f}{W_a} = f\left(\frac{V_D}{P_D^{0.61}\, D^{0.74}}\right)$$

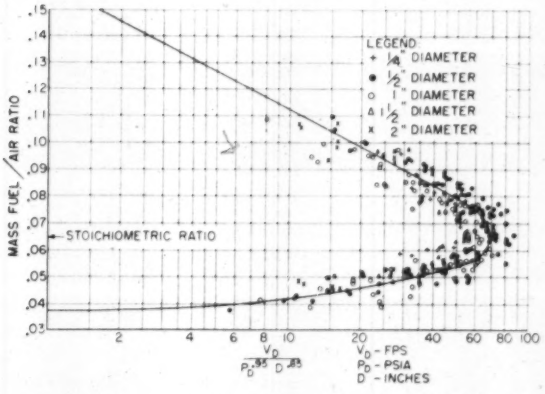
An analysis similar to that used by Longwell and coworkers in which the limits of flammability are based on maximum reaction possible in a homogeneous chemical reactor shows good agreement between experiment and theory.

Applied Mechanics

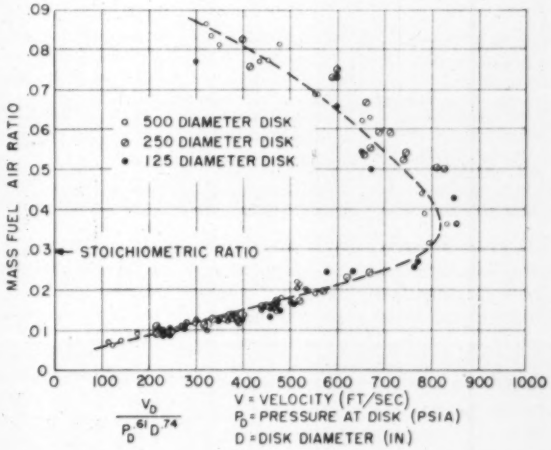
Vibration of Triangular Cantilever Plates by the Ritz Method, by B. W. Andersen, North American Aviation, Inc., Downey, Calif. 1954 West Coast Applied Mechanics Conference paper No. 54—APM-6 (in type; available to April 1, 1955; to be published in the *Journal of Applied Mechanics*).

USING the method published by Ritz in 1909, natural frequencies and corresponding node lines have been determined for two symmetric and two antisymmetric modes of vibration of isosceles triangular plates clamped at the base and having length-to-base ratios of 1, 2, 4, and 7 and for the two lowest modes of right triangular plates clamped along one leg and having ratios of the length of the free leg to that of the clamped one of 2, 4, and 7.

A nonorthogonal co-ordinate system



Stability characteristics of disks. Blowout points for propane air mixtures of disk sizes from 1/4 to 2 in. in 2.75-in. duct.



Flame-stability characteristics of disks using hydrogen-air mixtures at 535 deg R

was used which gave constant limits of integration over the area of the triangle. The co-ordinate transformation made it necessary to modify the functions used by Ritz in approximating deflections and to consider cross products in the integration. The integration was done numerically, using tables compiled by Young and Felgar in 1949.

To check the accuracy of results, a solution was obtained to the problem of a vibrating cantilever beam of uniform depth and triangular plan view.

The results obtained were found to be consistent with those obtained for the plates by using an eight-term series to approximate the deflections of the symmetric plates (isosceles triangles) and a six-term series to approximate the deflections of the unsymmetric plates (right triangles).

A Simple Nomogram for the Ratios of Octahedral to Maximum Shearing Stresses and Its Physical Interpretation, by G. A. Zizicas, University of California, Los Angeles, Calif. 1954 West Coast Applied Mechanics Conference paper No. **54—APM-9** (in type; available to April 1, 1955; to be published in the *Journal of Applied Mechanics*).

A NOMOGRAM constructed exclusively by means of straight lines is presented, giving the ratio of the octahedral to the maximum shearing stresses for all possible stress distributions in terms of the nondimensional ratios of the two principal stresses to the one of maximum absolute value.

The physical interpretation of the nomogram is discussed. It is shown that states of stress with constant ratio of octahedral to maximum shearing stress are represented by straight lines.

Polyaxial Stress-Strain Relations of a Strain-Hardening Metal, by S. B. Batdorf, Mem. ASME, Westinghouse Electric Corp., East Pittsburgh, Pa., and Bernard Budiansky, Langley Aeronautical Laboratory, Langley Field, Va. 1954 West Coast Applied Mechanics Conference paper No. **54—APM-2** (in type; available to April 1, 1955; to be published in the *Journal of Applied Mechanics*).

THE authors assess a plastic stress-strain law of anisotropic strain-hardening type which they previously developed on the basis of explicit consideration of the polycrystalline nature of metals and the mechanism of plastic deformation. The assumptions made are reviewed, together with the successes and limitations of the theory. The authors indicate the lines along which they feel that improvement of the theory is to be sought.

Steady-State Vibrations of Beam on Elastic Foundation for Moving Load, by J. T. Kenney, Jr., Assoc. Mem. ASME, Sandberg-Serrell Corp., Pasadena, Calif. 1954 West Coast Applied Mechanics Conference paper No. **54—APM-8** (in type; available to April 1, 1955; to be published in the *Journal of Applied Mechanics*).

THIS paper presents an analytic solution and resonance diagrams for a constant-velocity moving load on a beam on an elastic foundation including the effect of viscous damping.

The limiting cases of no damping and critical damping are investigated. The possible velocities for the propagation of free bending waves are found and their relation to the critical velocity of the beam is studied.

ASME Transactions for September, 1954

THE September, 1954, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Technical Papers

Reflection of Flexural Waves at the Edge of a Plate, by T. R. Kane. (53—A-42)

Forced Motions of Elastic Rods, by G. Herrmann. (53—A-59)

Creep Tests of Rotating Disks at Elevated Temperature and Comparison With Theory, by A. M. Wahl, G. O. Sankey, M. J. Manjoine, and E. Shoemaker. (53—A-61)

Elasticity of Cubic Polycrystals, by A. V. Hershey. (53—A-62)

Plasticity of Face-Centered Cubic Polycrystals, by A. V. Hershey. (53—A-63)

Measurement of Mobility, by R. Plunkett. (53—A-45)

Internal Damping of Machine Members, by A. W. Cochardt. (53—A-44)

On Bending of a Flat Slab Supported by Square-Shaped Columns and Clamped, by S. Woinowsky-Krieger. (53—A-60)

Impulsive Response of Beams in the Elastic and Plastic Regions, by W. T. Thomson. (54—APM-5)

Abstracts of Papers Presented at the Second U. S. National Congress of Applied Mechanics.

Design Data

A Simple Nomogram for the Ratios of Octahedral to Maximum Shearing Stresses and Its Physical Interpretation, by G. A. Zizicas. (54—APM-9)

Brief Notes

Impulsive Loading on an Elastic Half-Space, by J. H. Huth and J. D. Cole.

Influence of Primary Creep on Column Buckling, by F. K. G. Odqvist.

Bending of Plates Bounded by Conics and Clamped, by S. Woinowsky-Krieger.

On the Rate of Growth of Fatigue Cracks, by F. A. McClintock and F. J. Ryan.

Rounded Corner of a 90-Deg Elbow—Two-Dimensional Potential Flow, by Robert Lowy.

Discussion

On Previously Published Papers by L. A. Pipes; H. D. Conway; Morris Morduchow; and J. L. Bogdanoff.

Book Reviews

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54—SA-32	54—SA-71
54—SA-33	54—SA-72
54—SA-34	54—SA-75
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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Joint Authorship of a Scientific Paper

Comment by E. O. Hulburt[1]

ATTENTION was drawn recently to the matter of joint authorship by W. Forstall, Jr., and W. F. Stokey,[2] Carnegie Institute of Technology. The article is excellent and well balanced. I agree wholeheartedly with many of the conclusions and disagree just as wholeheartedly with others. Since many people work continually in co-operation with others and produce many reports and papers under joint authorship, the subject is of interest.

Importance of Authorship

For the purpose of discussion the following points are lifted from the article:

The question of authorship arises because of the extreme professional importance to the individual of having his name appear as the author of a paper. Recognition, reputation, promotion, and salary often depend heavily on this factor.

The author who makes the biggest contribution should be named first.

In considering who qualifies for authorship it must be remembered that a technical paper is the product of an "intellectual" effort. Those who contribute materially in invention, independent judgment, qualify for authorship. Operations like typing, drawing figures, making calculations and measurements already planned do not qualify. However, these suggested criteria are only a start and the subsequent questions of degree, like all such problems in human relations, involve boundaries that cannot be defined sharply.

It is the job of the research director to suggest problems that need attention and to specify that certain ones be investigated but this administrative function does not in itself make him an author of any resulting paper.

Now, to get to our discussion—is the question of authorship "of extreme professional importance?" Does the "recognition, reputation, promotion, and salary" of a man depend heavily on his published papers? I believe that the answer to these two questions is clearly "yes" in many academic circles, but not so clearly "yes" in industrial and government institutions. I think that this should not be so, because it puts too high a premium on the written word. If it is so it is a fault in those who judge the man, or who promote him, or who raise his salary.

There is no question that the written word is very valuable and that many a research or development is not complete until it is recorded in a report. (In this discussion "published papers" include industrial, government, or departmental reports, classified or unclassified, as well as papers in technical magazines of national societies.) But a written report is only a part of the work. After all, it is the work itself and its results that are important. And the written story about it giving the details and the conclusions must be recognized for what it is and not be overemphasized. Therefore a man's work should not be judged entirely by his written articles or reports. If there is proper balance, the question of authorship of an article or report does not assume such an acute form.

We have used the word "balance" to indicate that there is an obligation on both sides. There is an obligation on those who judge the value of a man's work to do so indeed with the aid of his written word, but also to look through this at the man and his work itself. There is an obligation on the man to write the report, because his work is not finished until it is recorded on paper.

Sequence of Authorship

The author who makes the biggest contribution should be named first. I disagree violently with this, or rather, I think that the order of names is entirely trivial. I do not see any reason why the first or last position is the preferred one in a list of authors. I would suggest that the names be put alphabetically or euphonistically, or ad libitum.

If there is a preferred position, for example the first, then the author who actually does most of the writing should, if he is a gentleman, put the other author's name in the preferred position. When I see a series of papers with a given author's name always in a certain position I draw my own conclusions.

Who qualifies for authorship? I agree with the conclusion that no matter what criteria one puts down one becomes involved in boundaries that cannot be defined sharply, as in all such problems of human relations. In a large research laboratory the scientists are provided with many services and facilities all operated by people; those services which are concerned with the work itself, as machine shops, glass blowing, numerical computation, ships, airplanes, rockets, and large accelerators, and those services which are concerned with the preparation of the paper or report as typing, drafting, and editorial services.

In most of these cases there is no problem; the people who operate the services do not qualify, nor do they expect to qualify, as authors of the scientific papers and reports which their work has helped to produce. I have one thought here. If a man has made an unusually fine series of measurements, an extended series of numerical computations, or an unusually fine manipulation of an equipment, which has been crucial to the investigation and there is doubt whether or not to include him as an author, it is best to lean over backward and to put him down wholeheartedly as author rather than to give him recognition by some dismal artifice as a footnote or a cheerful acknowledgement at the end of the report.

The Group-Leader's Problem

The leader of a group, or the director of a research, as a university professor or a section head at a research laboratory, encounters the problem of joint authorship continually. Considering first, the university professor, let us assume that his professional business is to do research himself and to teach graduate students to do research. In the case of his own researches he may have no problem of joint authorship or in any case he can

[1] Naval Research Laboratory, Washington, D. C.

[2] "When Should a Paper Have Joint Authorship?" by W. Forstall, Jr., and W. F. Stokey, MECHANICAL ENGINEERING, vol. 75, November, 1953, pp. 875–876.

deal with it on its own merits just as any other researcher.

In the case of his students he is in a different position. Here he sets the student a problem; this means that he gives the student an idea to work out, perhaps one of his best ideas. Now an idea, a good idea, is a grain of gold; it is the stock-in-trade of the researcher. The student probably does not realize, or perhaps appreciate fully, what the professor has given him. But once the professor has given the idea to the student there is no retraction; it is the student's property to use as best he can, with, of course, directive help from the professor (here is where teaching comes in) until he is able to stand on his own feet.

Some professors, I believe, pass out their ideas with strings attached to them, requiring, for example, that their names be included in any published reports. In some cases this method is justified; in others it may not be justified.

Credit for Section Head

The professional business of a section head at a research laboratory is to do problems of a research nature; I am including pure research, applied research, development, and test. The problems may arise from his own ideas, from those in his section, or from the outside. He assigns the problems to his various groups and to a greater or lesser extent provides advice, suggestions, personal aid, supervision, and enthusiasm in the course of the work. Reports are prepared and he is faced with the question whether to include himself as author. In some cases he may feel that he has not contributed enough to qualify as author; and in other cases he may feel that he has made material contributions to the work but does not wish to push himself in, because from one point of view he has only done what it was his business to do.

I sympathize very much with him in this situation, because I think that many times the section head should be included among the authors of a report. Some sections print the section head's name at the bottom of the title page of all their reports; this may be a satisfactory solution but it seems rather routine and almost meaningless. It is appropriate only in a laboratory report but would be out of place in a paper published in a magazine of a scientific society.

I know of no really satisfactory solution. Perhaps it is not an important matter. Perhaps a solution is to include the section head, or the group leader, as an author if he has contributed materially to the scientific aspects of the work, and not to do so if he has not made such contribution. But who is to judge?

Perhaps the workers themselves should suggest that their supervisor be included as an author when they feel that it is justified but perhaps they are not experienced enough, or feel that it is not their place, to do this.

Authors' Closure

The authors wish to thank Dr. Hulburt for his thoughtful and well-written contribution to the discussion of joint authorship. We are especially pleased that he understood so well the spirit in which we tried to present our ideas on this subject.

We mentioned the professional pressures to publish merely as an important factor working against a purely objective decision on authorship. A discussion of the reasons for the existence of these pressures, the tendency to rate a man on the quantity rather than the quality of his papers, and the ability of a man's publication history to reflect his real worth in teaching or in industrial or government research, is a somewhat separate topic well worthy of consideration in its own right. Dr. Hulburt's suggestion of a double obligation in this regard is very well expressed.

Principal Contributor First

We proposed that the principal contributor be named first for at least two reasons. First, because we believe that this is the scheme most generally used and for most readers this is the interpretation which will be placed on the order of names. If every one would agree on a uniform plan, such as alphabetical order, this argument would be demolished but we feel that the chances are slim for any such uniformity of practice and hence uniform and correct interpretation on the part of the reader.

Secondly, multiauthored papers tend to be referred to by the name of the first author. This inevitably gives extra prominence to the man named first and we thought it reasonable that the principal contributor have this advantage. Dr. Hulburt recognizes that an advantage exists (and the common interpretation of name order) when he draws conclusions from one man's name being repeatedly first or last.

Certain Criteria Needed

We cannot agree with the suggestion that a purely manipulative job, even of superior quality, might warrant authorship. The motion-picture industry has attempted to solve this problem by printing credits catalogued by function. The idea is sound but it was overdone until recognition was buried among a forest of names. As matters stand now with scientific papers, we do not see why proper mention, in the body of the article, of technical skill which made the work possible should be scorned as unworthy. One might speculate facetiously that if the present trend toward multiauthored papers continues, there may some day be more prominence in special mention in the article than in listing as an author. Seriously, if authorship listing is not to become a mere catch-all for credits, certain criteria should be agreed upon in a general way by the engineering and scientific community. Such criteria might also make easier the decision of the professor or the research director, whose problems concerning authorship are so well described in Dr. Hulburt's last two paragraphs.

W. Forstall, Jr.[3]
W. F. Stokey.[4]

[3] Associate Professor, Department of Mechanical Engineering, Carnegie Institute of Technology. Mem. ASME.
[4] Assistant Professor, Department of Mechanical Engineering, Carnegie Institute of Technology. Assoc. Mem. ASME.

Welding Tubes to Tube Sheets

Comment by R. W. Bennett[5]

THE authors are to be complimented for the excellent review[6] they have presented. The joint design (which includes tube-sheet layout), welding processes, and metals to be welded are certainly the basic factors that must be carefully evaluated to join tubes to tube sheets satisfactorily for unfired heat-transfer equipment.

The generalized statement and discussion by the authors, "Welding of a joint in which the thicknesses of the members differ by more than a ratio of 4:1 is exceedingly difficult and under some conditions may be impossible without burning

[5] Chief Metallurgical Engineer, Alco Products Division, American Locomotive Company, Dunkirk, N. Y.
[6] "Welding Tubes to Tube Sheets," by H. A. Huff, Jr., and A. N. Kugler, MECHANICAL ENGINEERING, vol. 76, May, 1954, pp. 421–425, 433.

Fig. 1 Heat exchanger containing Type 304 tubes heliarc-welded to a Type 347 tube sheet

the thinner member," indicates that the data presented are directed to the fabrication of low-pressure exchangers having light gage tubes and tube sheets. For example, a 16-gage (0.065-in.) tube welded to a tube sheet roughly $^1/_4$ in. thick would fall within the limits of this 4:1 material-thickness ratio. Without doubt, the joint designs, welding processes, materials, and their limitations discussed in this paper are accurate when applied to joining tubes to tube sheets in low-pressure exchangers. Many of these limitations, however, are not applicable to heavy heat-transfer equipment that is subjected to high operating pressures and other service conditions encountered in the power, chemical, petroleum, and atomic-energy installations.

On the majority of heat exchangers and heaters, a rolled tube joint generally is considered adequate. In recent years, however, for special service conditions, there has been an ever-increasing number of exchangers requiring the tubes to be welded to the tube sheets regardless of the material-thickness ratio. Such welds may fall into the category of seal welds or full-strength welds made by either the metallic-arc or heliarc process.

The authors state that if the tube sheet-to-tube thickness ratio exceeds 4:1, it will be necessary to resort to braze or braze welding. It has been our experience that the metallic-arc and heliarc processes are more applicable and suitable for joining the tubes into heavy tube sheets than by brazing or braze welding. A typical example is shown in Fig. 1 of this comment. This exchanger consists of about 2500–$^1/_2$-in. × 18-BWG type 304 tubes heliarc-welded to a $3^3/_4$-in. type 347 tube sheet. The material-thickness ratio in this case would be 75:1.

Fig. 2 shows a chart of specific tube and tube-sheet materials having a thickness ratio of 15:1, or greater, that have been fusion-welded satisfactorily by the metallic-arc or heliarc process for heavy heat-transfer equipment.

TUBE MATERIAL

TUBE SHEET MATERIAL	C. STEEL	1Cr-½Mo	5Cr-½Mo	TP 410	TP 430	TP 304 ELC	TP 304	TP 316	TP 347	NICKEL	MONEL	70-30 Cu-Ni	COPPER	RED BRASS	HAST C.
C. STEEL	A1	A2	A7	A7	X	X	A7	X	X	A10	A11	X	X	X	X
1Cr-½ Mo	X	A2	X	X	X	X	X	X	X	X	X	X	X	X	X
5 Cr-½ Mo	X	X	A3 A7 B3	A7	X	X	A7	X	X	X	X	X	X	X	X
TP 410	X	X	X	A7	X	X	X	X	X	X	X	X	X	X	X
TP 430	X	X	X	X	A4	X	X	X	X	X	X	X	X	X	X
TP 304 ELC	X	X	X	X	X	B0 B5	B0 B5	X	X	X	X	X	X	X	X
TP 304	X	X	X	X	X	B0 B5	A8 B0 B5	X	X	X	X	X	B13 B14	X	X
TP 316	X	X	X	X	X	X	X	A8	X	X	X	X	X	X	X
TP 347	X	X	X	X	X	X	A9 B9	X	A9 B5 B9	X	X	X	X	X	X
NICKEL	X	X	X	X	X	X	X	X	X	A10 B10	A11	X	X	X	X
MONEL	X	X	X	X	X	X	X	X	X	A11	A11	X	X	X	X
70-30 Cu-Ni	X	X	X	X	X	X	X	X	X	X	X	A12 B12	X	X	X
EVERDUR	X	X	X	X	X	X	X	X	X	X	X	X	X	B14	X
HAST. C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	B15

WELDING PROCESS
A. METAL ARC
B. HELIARC

FILLER METAL
0. NONE
1. C. STEEL
2. 1 Cr-½ Mo
3. 5 Cr-½ Mo
4. TYPE 430
5. TYPE 308 ELC
6. TYPE 308
7. TYPE 310
8. TYPE 316
9. TYPE 347
10. NICKEL
11. MONEL
12. 70-30 Cu-Ni
13. EVERDUR
14. AL. BRONZE
15. HAST C.

Fig. 2 Tube and tube-sheet materials that have been fusion-welded for heavy heat-transfer equipment
(X indicates no data available.)

Authors' Closure

The authors are appreciative of Mr. Bennett's comments which add materially to the data on this subject. In a general treatment of this subject, where the allotted space is limited, it is unfortunate that many details must be omitted or treated inadequately.

This is the case in the matter of relative thicknesses of tubes and tube sheets. The statement in the paper, with respect to thickness ratios, is intended more as a caution than as a specific limitation. It must be appreciated that this is a general treatment of the subject, encompassing all metals used in heat exchangers. Therefore metal-thickness ratios are dependent, to some extent, upon the metals involved. Thickness ratio would be more severe with some metals, e.g., aluminum.

This problem has been solved in many ingenious ways. One of these solutions involves the use of specially machined grooves, in the tube sheet around the tubes, to create "lips" at the juncture with the tubes. These lips or ridges provide, in effect, a joint the component parts of which are essentially the same thickness. This then is in line with the limitation thickness ratios and points up the fact that this is a real production problem.

If this caution, as stated in the paper, enables a fabricator to avoid difficulty in this matter, then it will have served its intended purpose.

H. A. Huff, Jr.[7], A. N. Kugler.[7]

[7] Air Reduction Sales Company, New York, N. Y.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Design for Decision

DESIGN FOR DECISION. By Irwin D. J. Bross. The Macmillan Company, New York, N. Y., 1953. Cloth, 5 × 8¼ in., references, figs., index, viii and 276 pp., $4.25.

Reviewed by Ercole Rosa, Jr.[1]

THIS book brings to bear upon the problem of decision-making the results of study and investigation in many fields of science and practice. The approach is sound and general enough so that decision-making in any activity benefits from the analysis.

It is widely recognized that the evaluation of alternative choices is an application of probability relationships: If I take this path, what is the likelihood that I will achieve my desired goal? This has led to the development of extensive experience functions involving probability expressions for various types of situations. The most productive original thinking in this field was done by the late Abraham Wald.[2] Other important contributions have come from econometricians, students of Game Theory, and from industrial engineers. The bulk of this work is involved and requires considerable formal preparation in mathematics and statistics for application. The author's great contribution is the summarization and the presentation of these developments in a form which permits those with minimal preparation in these fields to derive real benefit and satisfaction. Even the field of cybernetics makes its appropriate contribution to the more effective handling of decisions.

The work covers each of the phases and aspects of decision-making. It includes a study of decision-making practice in the past with reference to different periods, different cultures within those periods, and to the interaction of the culture upon decision-making practice. Prediction, probability, sampling, and statistical inference are throughly discussed in their relationship to decision-making. Data, measurement, and the construction of models receive considerable attention. Sequential decisioning, already formalized in its application to quality control, is examined in its application to the solution of complex managerial problems. The section on values—subheaded "The values of science and the science of values"—contains many provocative statements concerning the measurement of utility and its relation to decision-making. The annotated bibliography provides many opportunities for those who wish to pursue further the challenging ideas concerning decisioning.

[1] Assistant Professor of Management, Hofstra College, Hempstead, L. I. Assoc. Mem. ASME.

[2] "Statistical Decision Functions," by A. Wald. John Wiley and Sons, Inc., New York, N. Y., 1954.

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Books Received in Library...

ANTI-FRICTION BEARINGS. By Hudson T. Morton, 815 Wildt Street, Ann Arbor, Mich., 1954. 395 p., 11¼ × 9½ in., spiral binding. $7.75. A comprehensive treatment of types, sizes, load characteristics, and criteria of selection, intended for designers, manufacturers, and engineers. Included is material on typical applications and mountings, load-computation formulas, and tables of fits, standard shoulder heights, and dimensions of mating parts. There is also information on past and present manufacturers. Bibliographies are included.

ARTIFICIAL FIBRES. By R. W. Moncrieff. John Wiley & Sons, Inc., New York, N. Y., second edition, 1954. 455 p., 8¼ × 5¾ in., bound. $6. The subject is covered in five main divisions: The structure and properties of fibers in general; regenerated cellulosic and alginic fibers; regenerated protein fibers; synthetic fibers; and processing of fibers. The history, chemical nature, manufacture, properties, dyeing, and uses of each type are discussed. Coverage has been extended to include new fibers, new methods of dyeing, additional material on staple blending, and a chapter on economic and social aspects of artificial-fiber production.

DIESEL ENGINE CATALOG, Volume 19, 1954-1955. Edited and published by Rex W. Wadman. Diesel Engines, Inc., Los Angeles, Calif. 390 p., 13¾ × 10¾ in., bound. $10. Details on the engines and auxiliary equipment produced by the major manufacturers are given in this book. New designs and developments of the past year have been added to this edition and the accessories section has been expanded.

ELECTRIC POWER TRANSMISSION. The Power System in the Steady State. By John Zaborszky and Joseph W. Rittenhouse. Ronald Press Company, New York, N. Y., 1954. 676 p., 9¼ × 6⅜ in., bound. $12.50. Designed both as a textbook and a reference work for practicing engineers. Partial contents are the basic structure of power systems; inductive and capacitive reactances; conductor resistance; corona; constants of underground cables; performance in the steady state; voltage and load-frequency regulation; power-system economics. References are given after many of the sections of the text.

ELEMENTS OF FOOD ENGINEERING, Volume 2. By Milton E. Parker. Reinhold Publishing Corporation, New York, N. Y., 1954. 360 p., 9¼ × 6¼ in., bound. $8.50. In this volume, fundamentals of the design, construction, methods, and equipment for food processing are considered. Unit operations—cleaning, coating, drying, etc.—are discussed in three sections covering assembly, preparation, and conversion of raw materials. The first volume was concerned with origins, properties, and classifications of foods, the scope and extent of the industry, and refined-foods processing. A third volume will discuss operations.

FERTIGUNGS-UND STOFFORRECHTES GESTALTEN IN DER FEINWERKTECHNIK. (Konstructionsbücher, No. 13.) By Karl-Heinz Sieker. Springer-Verlag, Berlin, Germany, 1954. 166 p., 9 × 6⅛ in., paper. 21 DM. Design of precision parts in relation to mass-production techniques and properties of materials. Section 1 on metal components covers forming and shaping by cutting, stamping, casting, and powder metallurgy. Section 2 on nonmetallic components deals with laminating, molding, and ceramics. Many diagrams and practical examples are included.

GREEN LEAF GUIDE. National Reference Guide for the Patent Field. Field Publications, Port Washington, N. Y., 1954-1955 edition. 64 p., 9 × 6 in., paper. $2. Revised and enlarged listings of some 600 companies, classified by fields of interest, provide inventors with a guide to firms now producing or looking for many types of inventions. A separate section explains functions of government services and publications in the patent field and gives a table showing how to date a patent from its number.

INDUSTRIAL STOICHIOMETRY. Chemical Calculations of Manufacturing Processes. By Warren K. Lewis, Arthur H. Radasch and H. Clay Lewis. McGraw-Hill Book Company, Inc., New York, N. Y., second edition, 1954. 429 p., 9⅛ × 6¼ in., bound. $7.50. The purpose of this book is to introduce the plant operator and student to the techniques of analysis and interpretation of technical infor-

mation on industrial processes involving chemical reactions. Techniques of computation involved in combustion problems and in the sulphur, nitrogen, lime and cement, fixed alkali, metallurgical, and ceramic industries are treated. There is a design-problem chapter.

JOB EVALUATION METHODS. By Charles Walter Lytle. Ronald Press Company, New York, N. Y., second edition, 1954. 507 p., $9^1/_4 \times 6^1/_4$ in., bound. $7.50. The subject is treated analytically with each chapter covering a functional step in setting up a plan for job evaluation: policy and organization; methods and techniques; selecting job characteristics; job analysis, rating, and classification, etc. New applications and procedures are taken into account and there is a new chapter on wage-incentive methods.

OPERATIONS RESEARCH—CHALLENGE TO MODERN MANAGEMENT. Graduate School of Business Administration, Harvard University, Cambridge, Mass., 1954. 120 p., $11 \times 8^1/_2$ in., paper. $10. This report, written to aid management in evaluating the possibilities of applying the methods of operations research to specific situations, discusses the need, historical development, and applications of the method in planning production, setting time standards, etc. Separate chapters describe the methodology and the relation of computers to the subject. A selected bibliography is included.

PAPERS OF WILBUR AND ORVILLE WRIGHT. Volume 1: 1899–1905; Volume 2: 1906–1948. Edited by Marvin W. McFarland. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 1278 p., $9^1/_4 \times 6^1/_4$ in., bound. $25./2 vol. All papers of the Wright brothers relevant to the evolution of the airplane and the principles of flight are included, as well as purely biographical material which contributes to continuity or sheds light on aviation affairs. Arrangement is chronological with volume 1 covering 1899–1905, volume 2, 1906–1948. Appendixes summarize and interpret significant subjects such as wind-tunnel experiments, propellor theory, etc., and there is a bibliography of published writings of the Wrights.

PRACTICAL PIPING FLEXIBILITY—DESIGN AND FLOW. By W. A. Thomas, 2742 Philadelphia Avenue, Pittsburgh, Pa., 1953. 188 p., $9 \times 6^1/_2$ in., loose-leaf binder. $25. Presents the author's method—based on model tests and available results of full-scale tests—for rapid checking of results obtained by more detailed methods of analysis of thermal stress and reactions in piping systems. Related topics are also treated in sections on flow of liquids, economical pipe size, pumping data, flow of steam, and other subjects. Supplementary pages recording changes in methods are to be issued.

PRINCIPLES OF EXPERIMENTAL STRESS ANALYSIS. By Mark B. Moore. Prentice-Hall, Inc., 1954. 146 p., $8^3/_4 \times 5^3/_4$ in., bound. $4. Fundamental principles are examined and the relative usefulness and difficulty of some of the more common techniques are evaluated, with emphasis on the use of the electric strain gage. Suggested laboratory experiments are arranged in sections corresponding to the chapters of the text. The book is intended as a text for a one-semester undergraduate course.

QUALITY CONTROL. By Norbert L. Enrick. Industrial Press, New York, N. Y., second edition, 1954. 181 p., $9^1/_4 \times 6^1/_4$ in., bound. $4. Retains the character of the first edition—a manual for the practical man. The revision consists of the addition of a second part dealing with additional control charts for variables, control charts for defectives, and for acceptance inspection, and with the analysis of variance. The latter subject is handled in a modified form suitable for the beginner.

RELATION OF PROPERTIES TO MICROSTRUCTURE. American Society for Metals, Cleveland, Ohio, 1954. 270 p., $9^1/_4 \times 6^1/_4$ in., bound. $5. Twelve papers review the knowledge of the field, recent research on interactions of dislocations with structural elements, and applications to alloy design. Specific subjects considered are structure-sensitive properties, grain boundaries, brittle fracture, corrosion, and magnetic properties. References are listed after each paper.

RESIDUAL STRESSES IN METALS AND METAL CONSTRUCTION. Edited by William R. Osgood. Reinhold Publishing Corporation, New York, N. Y., 1954. 363 p., $9^1/_4 \times 6^1/_4$ in., bound. $10. Twenty-two papers by specialists, prepared for the Ship Structure Committee by the Residual Stress Committee of the National Research Council. The papers cover a wide range of subjects related to the origin, magnitude, and distribution of stresses in structures and machines, with emphasis on possible contributions of stresses to fracture. There are separate bibliographies for each paper and a list of general sources.

STRUCTURE OF METALS AND ALLOYS. (Monograph and Report Series, No. 1). By William Hume-Rothery and G. V. Raynor. Institute of Metals, London, England, third edition, 1954. 363 p., $8^3/_4 \times 5^3/_4$ in., bound. $5.50. The present edition, like the first, 1936, is written on an elementary level and deals mainly with the structure and composition limits of single phases. Topics covered include electronic background, crystal structure of elements, atomic radii, primary metallic solid solutions, intermediate phases in alloy systems, and imperfections in crystals. A new section on steel and cast irons has been added, and the complete text brought up to date.

SURFACE PROTECTION AGAINST WEAR AND CORROSION. American Society for Metals, Cleveland, Ohio, 1954. 461 p., $9^1/_4 \times 6^1/_8$ in., bound. $6. The first part of this book is a summary of techniques and metallurgical facts that aid craftsmen, technicians, and engineers in minimizing surface wear of metallic materials. Among the processes dealt with are plating, metal spraying, hard facing, etc. The second part contains eight lectures on surface protection against corrosion, covering economics, specifications, and various types of coatings. Each chapter has references.

SYMPOSIUM ON FLUORESCENT X-RAY SPECTROGRAPHIC ANALYSIS. (Special Technical Publication, no. 157.) American Society for Testing Materials, Philadelphia, Pa., 1954. 68 p., 9×6 in., paper. $1.75. The six papers included cover basic theory and fundamentals, x-ray intensity and chemical composition, multichannel recording, the examination of metallic materials, and methods of analyzing stainless steels and minerals.

TECHNISCHE STROMUNGSLEHRE. By Bruno Eck. Springer-Verlag, Berlin, Germany, fourth edition, 1954. 422 p., $9^3/_8 \times 6^3/_8$ in., bound. 29.40 DM. This treatise on hydrodynamics covers the basic principles of various types of flow at considerable length, with particular attention to the influence of friction. These principles are then utilized in the analysis of blade and propeller action, airfoils, cavitation, etc. The motion of solid bodies in a flowing medium, such as in dust collectors and pneumatic conveyers, is considered. There is a final chapter on flow-measuring methods and apparatus.

THERMODYNAMICS REFRESHER FOR PROFESSIONAL ENGINEERS LICENSE. By John D. Constance, 625 Hudson Terrace, Cliffside Park, N. J., 1954. Various paging, $8^1/_2 \times 11$ in., paper. $3.25. This separate publication is a revision and enlargement of the section on the subject in the author's Refresher Notes. Additions have been made which are intended to increase the value of the material to examination candidates in all states. There is a new section on air conditioning, and other subjects, for example heat transfer, are treated more extensively.

"TIMING" BELT DRIVE ENGINEERING HANDBOOK. By Richard Y. Case. McGraw-Hill Book Company, Inc., New York, N. Y., 1954. 189 p., $8^1/_2 \times 5^3/_4$ in., bound. $3.50. Provides the designer with engineering data needed for incorporating timing-belt drives in new or redesigned machinery and equipment. Information is given on the design and construction of belts and pulleys, length and width calculations, and applications in a variety of fields—automotive, electronic, machine tool, etc. An appendix includes drive-selection tables, formulas, and installation pointers.

TRANSACTIONS OF THE SYMPOSIUM ON FLUID MECHANICS AND COMPUTING. (First Symposium on Applied Mathematics.) American Mathematical Society and Office of Ordnance Research, U. S. Army, Interscience Publishers, Inc., New York, N. Y., 1954. 243 p., $10^1/_4 \times 7$ in., bound. $5. Various topics in the fields of mathematics, fluid mechanics, mathematical physics, and computer techniques are considered in fourteen separate papers. Among the papers are several on transonic flow and several on shock waves. Most papers include a list of references.

WATER HAMMER. Its Cause, Magnitude, Prevention. By Oscar G. Goldman. Columbia Graphs, Columbia, Conn., 1953. 116 p., $9^1/_4 \times 6^1/_8$ in., bound. $5. The purpose of this book is to give engineers a solution for all cases of water hammer. Methods of calculating surge intensity and suggestions for design that will eliminate the destructive effect of the phenomenon are developed from the concept that water hammer is due to the expansion and compression of the material in which the effect is produced.

WAVE MOTION AND VIBRATION THEORY. (Proceedings of Symposia in Applied Mathematics, Volume 5.) American Mathematical Society. McGraw-Hill Book Company, Inc., New York, N. Y., 1954. 169 p., $10^1/_4 \times 7^1/_8$ in., bound. $7. The fifteen papers included deal with various aspects of four topics: stability of fluid motions, hydrodynamic waves, diffraction and shattering problems, and vibration theory. Bibliographies accompany each paper and there is a combined index.

WERKSTOFF-HANDBUCH STAHL UND EISEN. Edited by Verein Deutscher Eisenhüttenleute, prepared by Karl Daeves. Verlag Stahleisen, third edition, 1953. Various paging, $8^3/_4 \times 7$ in., loose-leaf binder. 78 DM. A concise, authoritative compilation of basic data on the properties, uses, and testing of steels; each chapter written by an expert under the guidance of the Materials Committee of the VDE and with the co-operation of steel producers and consumers. The volume is divided as follows: generalities; properties and their testing; iron and steel types, their production and composition; steel types for specific applications; steel treatment and testing.

ASME NEWS

With Notes on the Engineering Profession

Influence of Science and Engineering on Modern Civilization 1954 ASME Annual Meeting Keynote

Significant Program Designed to Lead the Way in Several Avenues of Engineering. Headquarters: Hotel Statler, New York, N. Y., Nov. 28–Dec. 3.

Tentative Program

MONDAY, NOVEMBER 29

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (I)

Shell Theory I

Influence Coefficients for Hemispherical Shells With Small Openings at the Vertex, by *G. D. Galletly*, David Taylor Model Basin (Paper No. 54—A-4)

Membrane and Bending Analysis of Axisymmetrically Loaded Axisymmetrical Shells, by *G. Horvay* and *J. M. Clausen*, General Electric Co. (Paper No. 54—A-8)

Loaded Distribution at the Intersection of Several Coaxial Axisymmetric Shells, by *Herbert Becker*, New York University (Paper No. 54—A-43)

Buckling of Sandwich Cylinders Under Combined Compression, Torsion, and Bending Loads, by *Chi-Teh Wang, R. J. Vaccaro*, and *D. F. De Santo*, New York University (Paper No. 54—A-102)

Small Rotationally Symmetric Deformations of Shallow Helicoidal Shells,[2] by *Eric Reissner*, Massachusetts Institute of Technology (Paper No. 54—A-13)

9:30 a.m.

Aviation (I)—Materials Handling (I)—IAS (I)—SAE (I)—NSIA (I)—TAG (I)

The Role of the Turboprop and Turbojet Transports

Opening Remarks: Brig. General *J. P. Doyle*, USAF, Washington, D. C.

Economics of Possible Future Transport Airplanes (USAF-Rand Study), by *T. V. Jones*, Northrup Aircraft, Inc.[1]

Panel Discussion; Turboprop Versus Turbojets

George Schairer, Boeing Airplane Co.
Harold Hoekstra, Aircraft Engineering Division, C.A.A.
C. J. Walker, General Electric Co.
R. S. Hall, General Motors Corp.
R. L. Bayless, Research and Development, Convair

9:30 a.m.

Fuels (I)

Typical Small and Medium-Sized Industrial Steam-Plant Designs[1]

Typical Design for the Small-Sized Industrial Steam Plant[1]

Continuity of Design to Control Industrial Steam-Plant Investment and Operating Costs, by *C. E. Rodenburg* and *James M. Brown*, Ford, Bacon and Davis, Inc. (Paper No. 54—A-116)

Continuity of Design to Control Steam-Plant Investment and Operating Costs[1]

9:30 a.m.

Hydraulic (I)

Pumps and Pump-Component Performance

Pumping Hermetically Sealed Systems, by *B. Camelli*, Westinghouse Electric Corp. (Paper No. 54—A-119)

Design and Operation of Small Canned Motor Pumps, by *A. J. Mei*, Westinghouse Electric Corp. (Paper No. 54—A-120)

Water-Lubricated Bearing Development, by *W. M. Wepfer* and *E. J. Cattabiani*, Westinghouse Electric Corp. (Paper No. 54—A-121)

9:30 a.m.

Petroleum

Design Features in Heat Exchangers, by *W. E. Glausser* and *J. A. Cortright*, C. F. Braun & Co. (Paper No. 54—A-62)

Engineering Considerations in Plant Revamp Work, by *J. M. Black*, The M. W. Kellogg Co. (Paper No. 54—A-63)

9:30 a.m.

Lubrication (I)—Railroad (I)

Load Capacity and Time Relations for Squeeze Films, by *F. R. Archibald*, Arthur D. Little, Inc. (Paper No. 54—A-50)

Preliminary Investigation of Minimum Oil-Feed Rates for Fluid-Film Conditions in Journal Bearings, by *Dudley D. Fuller*, Columbia University, and *Bano Sternisicht*, General Electric Co. (Paper No. 54—A-107)

Bearing-Material Evaluation for Railroad Use, by *G. M. Robinson*, The Franklin Institute Labs. (Paper No. 54—A-110)

9:30 a.m.

Fluid Meters (I)

Flow Measurement Under Abnormal Conditions

Coefficients of Standard Orifices at Reynolds Numbers Between 4 and 50,000[1]

Special Devices for Flow Measurement at Low Reynolds Numbers[1]

Prepared Discussion of Papers 1 and 2 With Supplemental Information[1]

Effect of Mechanical Vibration on the Water Flow Through a 1/4-In. Sharp-Edged Concentric ASME Orifice in a One-Inch Pipe, *by C. B. Haughton, Jr.*, AVCO Mfg. Corp., and *R. E. Gorton*, United Aircraft Corp. (Paper No. 54—A-113)

9:30 a.m.

Education (I)—Management (I)

Accreditation and the Mechanical Engineer

Accreditation—What Is It All About?[1]

How Can Mechanical Engineers Contribute?[1]

Curriculum Inspection Experiences[1]

9:30 a.m.

Boiler-Feedwater Studies (I)

Chemical Treatment for Corrosion Control[1]

Hydrazine for Boiler-Feedwater Treatment by *Richard Harshman* and *Eric R. Woodward*, Mathieson Chemical Corp. (Paper No. 54—A-124)

9:30 a.m.

Mechanical Pressure Elements

Theories on Bourdon Tubes[1]

Sensitivity and Life Data on Bourdon Tubes[1]

The Influence of the Shape of the Cross Section on Behavior of Bourdon Tubes[2]

9:30 a.m.

Corrosion and Deposits From Combustion Gases—Power (I)

Lower Flue-Gas Exit Temperatures Through Removal of Solids Ahead of the Air Preheater[1]

The Sign Aspects of an Electrostatic Precipitator for Removal of Fine Solids Ahead of the Air Preheater[1]

12:15 p.m.

President's Luncheon

2:30 p.m.

Applied Mechanics (II-A)

Shell Theory II

Cylindrical Shells: Energy, Equilibrium, Addenda, and Erratum, by *E. H. Kennard*, David Taylor Model Basin (Paper No. 54—A-10)

The Effect of a Surrounding Fluid Medium on the Propagation of Pressure Waves in a Fluid-Filled Elastic Tube, by *M. C. Junger*, Harvard University (Paper No. 54—A-93)

Remarks on Donnell's Equations, by *Joseph Kempner*, Polytechnic Institute of Brooklyn (Paper No. 54—A-28)

The Accuracy of Donnell's Equations, by *Nicholas J. Hoff*, Polytechnic Institute of Brooklyn (Paper No. 54—A-105)

2:30 p.m.

Applied Mechanics (II-B)—Machine Design (I)

Theory of Machines

Acceleration in Mechanisms, by *R. T. Hinkle, Ching-U Ip*, and *J. S. Frame*, Michigan State College (Paper No. 54—A-33)

[1] See box on page 855.
[2] Presented by title only.

Synthesis of the Surfaces of Friction Skew Gears,[2] by *J. S. Beggs*, University of California (Paper No. 54—A-16)

A Kinematic Notation for Lower-Pair Mechanisms,[2] by *J. Denavit* and *R. S. Hartenberg*, Northwestern University (Paper No. 54—A-34)

Oil Streamlines in Bearings,[2] by *C. F. Kettleborough*, University of Melbourne, Melbourne, Australia (Paper No. 54—A-23)

2:30 p.m.

Aviation (II)—Materials Handling (II)—IAS (II)—SAE(II)—NSIA (II)—TAG (II)

Military Air Transports

(Paper to be announced)

The Lockheed C-130 Turboprop Military Transport[1]

2:30 p.m.

Fuels (II)—Power (II)—Air-Pollution Controls

The Mechanism of Separation in the Louver-Type Dust Separator, by *W. C. Holton*, Battelle Memorial Institute (Paper No. 54—A-117)

A Study of Spreader-Stoker Reinjection Systems[1]

Cleveland Co-Operative Meteorological and Air-Pollution Program[1]

2:30 p.m.

Hydraulic (II)

Pumps and Pump-Component Performance

Model Tests of the 84-In. Tracy Pump[1]

Through Flow in Concentric Annuli of Final Clearance With and Without Relative Motion of the Boundaries

Predicting Performance of Regenerative Pumps

An Hypothesis of the Fluid Dynamic Mechanism of Regenerative Pumps, by *W. A. Wilson*, Massachusetts Institute of Technology; *J. A. Oelrich*, Worthington Corp.; and *M. A. Santalo*, Massachusetts Institute of Technology (Paper No. 54—A-59)

Relationship of Regenerative Pump Performance to Casing Geometry, by *W. A. Wilson*, Massachusetts Institute of Technology; *J. A. Oelrich*, Worthington Corp.; and *M. A. Santalo*, Massachusetts Institute of Technology (Paper No. 54—A-60)

2:30 p.m.

Lubrication (II)—Metal Processing (I)

The Friction Process in Metal Cutting, by *Iain Finnie* and *Milton C. Shaw*, Massachusetts Institute of Technology (Paper No. 54—A-108)

Scoring Characteristics of Thirty-Eight Different Elemental Metals in High-Speed Sliding Contact With Steel, by *A. E. Roach, C. L. Goodzeit*, and *R. P. Hunnicutt*, General Motors Corp. (Paper No. 54—A-61)

Frictional Characteristics and Surface Damage of Thirty-Nine Different Elemental Metals in Sliding Contact With Iron, by *C. L. Goodzeit, R. P. Hunnicutt*, and *A. E. Roach*, General Motors Corp. (Paper No. 54—A-53)

2:30 p.m.

Fluid Meters (II)

Flow-Measurement Research

Results of Tests on Eccentric and Segmental Orifices in 4 Through 14-In. Lines[1]

Effect of a Globe Valve in Approach Piping on Orifice-Meter Accuracy, by *J. W. Murdock, E. J. Folts*, and *C. Gregory, Jr.*, Philadelphia Naval Base (Paper No. 54—A-122)

Flow of Saturated Boiler Water Through Knife-Edge Orifices in Series, by *E. S. Monroe, Jr.*, Cornell University (Paper No. 54—A-118)

Some Notes on Recently Published Experiments on Orifice Meters[1]

2:30 p.m.

Education (II)—Management (II-A)

Symposium: Accreditation Procedures and the Professional Responsibility of Mechanical Engineers

Panel Members:

H. L. Hazen, Massachusetts Institute of Technology
K. B. McEachron, Jr., General Electric Company
J. H. Davis, Stevens Institute of Technology

[1] See box on this page.
[2] Presented by title only.

Preprint Orders

ONLY preprints of *numbered* ASME papers will be available November 1. Some of these papers may not be available in time to permit your receiving them in advance of the meeting. Your order will be mailed only when the complete order can be filled unless you request that all papers available ten days before the meeting be mailed at that time. Please order only by paper *number;* otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the meeting.

Preprints of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons, in lots of ten, are $2 for members; $4 for nonmembers.

Preprints of unnumbered papers, listed by title only in the tentative program, *are not available* because the review of these manuscripts had not been completed when the program went to press. The author's name and preprint number will appear with paper title in the final program (final program available only at meeting) as well as the issue of MECHANICAL ENGINEERING containing an account of the meeting, if the paper is recommended for preprinting.

Chalmers Kirkbride, Houdry Process Corporation
S. C. Hollister, Cornell University

2:30 p.m.

Boiler-Feedwater Studies (II)

Chemical Deaeration of Boiler Water—The Use of Hydrazine Compounds, by *J. Leicester*, Admiralty Materials Lab., Dorset, England (Paper No. 54—A-123)

Controlling Iron and Copper Pickup With Neutralizing Amines[1]

Experiences at Springdale Station Using Various Chemicals as Oxygen Scavengers[1]

2:30 p.m.

ASME Research Activity—Management (II-B)

Proposed Research on Properties of Steam[1]

Progress Report on Research in Heat Conductivity of Gases[1]

Proposed Program on Ergonomics (Human Engineering)[1]

4:00 p.m.

Tea Dance

4:45 p.m.

Business Meeting

6:30 p.m.

Wood Industries Dinner and Session

Toastmaster: *Charles R. Nichols, Jr.*, L. B. Ramsdell Co., Gardner, Mass.

Woodworking as a Hobby for Engineers

Engineers Need a Hobby[1]

What Equipment Is Available for the Woodworking Hobby?[1]

Some Home-Workshop Products—How to Use the Small Power Tools[1]

The Wood Industries Division is staging an innovation at the Annual Meeting. It is motivated by the widespread "Do it yourself" theme and is based on the well-recognized fact that engineers are too serious-minded and do not play enough. Instead of regular and formal technical papers, there will be a symposium on the general topic of "Woodworking as a Hobby for Engineers." Speakers will be Ray DuBrucq, president of the Association of Manufacturers of Woodworking Machinery; John Fenchen of the Statler Hotels Staff, who made such a hit with his exhibit of woodshop products a couple of years ago at a meeting of the ASME Metropolitan section; and Thomas D. Perry, the veteran of the Wood Industry Division activities.

8:00 p.m.

Applied Mechanics (III-A)

Anelasticity

Anisotropic Loading Functions for Combined Stresses in the Plastic Range,[1] by *L. W. Hu* and *Joseph Marin*, Pennsylvania State University (Paper No. 54—A-9)

Prediction of Creep-Deflection and Stress Distribution in Beams From Creep in Tension, by *W. N. Findley*, Brown University, and *J. J. Pocsatek*, American Machine & Foundry Co., (Paper No. 54—A-5)

Fracture of Inoculated Iron Under Biaxial Stresses, by *I. Cornet* and *R. C. Grassi*, University of California (Paper No. 54—A-47)

The Formation of a Conical Crater in a Thin Plastic Sheet,[2] by *W. T. Thomson*, University of California (Paper No. 54—A-36)

8:00 p.m.

Fuels (III)—Gas Turbine Power (I)

Suppression of Burner Oscillations by Accoustical Dampers[1]

High-Frequency Oscillations of a Flame Held by a Bluff Body, by *A. E. Moreen*, General Electric Co., and *W. E. Kaskin* (Paper No. 54—A-66)

8:00 p.m.

Fluid Meters (III)

Flow-Measurement Research

The Dall Flow Tube[1]

Two and Three-Dimensional Flow of Air Through Sonic Orifices, by *A. Weir, Jr., J. Louis York*, and *K. B. Morrison*, University of Michigan (Paper No. 54—A-112)

On the Theory of Discharge Coefficients for Rounded-Entrance Flow Meters and Venturis, by *M. A. Rivas, Jr.*, and *A. H. Shapiro*, Massachusetts Institute of Technology (Paper No. 54—A-98)

8:00 p.m.

Junior—Education (III)—Management (III)

Panel: "Training the Engineer—Whose Job Is It?"

Moderator: *Robert Nelsen*, General Electric Co.

Panel Members:

Education: *David L. Arm*, University of Delaware; Industry: *D. F. Pratt*, Cincinnati Milling Machine Company

8:00 p.m.

Machine Design (II)—Applied Mechanics (III-B)—Boiler Code (I)

Rational Thickness Design for Pressure Vessels, by *P. M. Stafford*, South Dakota School of Mines and Technology (Paper No. 54—A-84)

Bracing Rectangular Tanks, by *L. D. Jennings*, Westinghouse Electric Corp. (Paper No. 54—A-83)

TUESDAY, NOVEMBER 30

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (IV)

Elasticity I

Approximate Stress Functions for Triangular Wedges, by *I. K. Silverman,* U. S. Bureau of Reclamation (Paper No. 54—A-14)

Thermal Shock on a Circular Surface of Exposure of an Elastic Half Space, by *M. A. Sadowsky,* Rensselaer Polytechnic Institute (Paper No. 54—A-44)

Determination of Thermal Stresses in Three-Ply Laminates, by *A. J. Durelli,* Illinois Institute of Technology; and *C. H. Tsao,* University of California (Paper No. 54—A-27)

Further Work on the General Three-Dimensional Photoelastic Problem, by *M. M. Frocht,* Illinois Institute of Technology; and *Roscoe Guernsey, Jr.,* General Electric Co. (Paper No. 54—A-11)

Stress-Concentration Factors in Shafts With Transverse Holes as Found by the Electroplating Method,[2] by *H. Okubo,* Nagoya University, Nagoya, Japan; and *F. Sato,* Tohoku University, Sendai, Japan (Paper No. 54—A-88)

Studies on Scabbing of Solids Under Explosive Attack, by *K. B. Brogerg,* Stockholm, Sweden (Paper No. 54—A-95)

9:30 a.m.

Aviation (III)—Materials Handling (III)—IAS (III)—SAE (III)—NSIA (III)—TAG (III)

Civil and Military Transports

The Boeing 707 Turbojet Tanker Transport[1]

The Convair C-131 Turboprop Transport[1]

Hurel-Dubois HD-32 (High-Aspect Ratio) Transport[1]

9:30 a.m.

Fuels (IV)—Gas Turbine Power (II)—Railroad (II)

Heat-Processing Combustible Materials by High-Temperature Gas Generation and by Direct-Flame Impingement[1]

Flame-Stabilized Oxy-Fuel Burners[1]

9:30 a.m.

Hydraulic (III)

Hydraulic Turbines

Hydraulic-Turbine Design Problems, by *J. Parmakian,* U. S. Bureau of Reclamation (Paper No. 54—A-68)

The Stability of Umbrella-Type Vertical Water-Wheel Generators[1]

Ultrasonic Measurement of Hydraulic-Turbine Discharge, by *W. B. Hess,* Safe Harbor Water Power Corp.; *R. C. Swengell,* and *S. K. Waldorf* (Paper No. 54—A-54)

9:30 a.m.

Machine Design (III)

Stresses and Deflections in Eccentrically Loaded Gear Teeth, by *Joseph Marin* and *Robert Shenk,* Pennsylvania State University (Paper No. 54—A-79)

The Influence of Tap-Drill Size and Length of Engagement Upon the Strength of Tapped Holes, by *C. J. Oxford, Jr.,* National Twist Drill & Tool Co.; and *J. A. Cook,* National Machine Products Co. (Paper No. 54—A-85)

The Design of the Expanding Friction Clutch,[2] by *M. J. Cohen,* Queen Mary College, London, England (Paper No. 54—A-86)

9:30 a.m.

Oil and Gas Power (I)

Dynamics in the Inlet System of a Four-Stroke Single-Cylinder Engine[1]

Centrifugal Scavanged, Two-Cycle Engines[1]

9:30 a.m.

Safety (I)—Nuclear Energy—Power (III)

Safety Considerations in the Operation of Nuclear-Power Reactors

General Criteria for Safe Reactor Design and Operation[1]

Basic Safety Procedures in Reactor Operation, by *R. L. Doan,* Phillips Petroleum Co. (Paper No. 54—A-71)

A Reactor Emergency—With Improvements Adopted as a Result[1]

The Disposal of Radioactive Wastes, by *Abel Wolman,* Johns Hopkins University, and *Arthur E. Gorman,* U. S. Atomic Energy Commission Division of Reactor Development (Paper No. 54—A-72)

9:30 a.m.

Metal Processing (II)

Residual Grinding Stresses in Hardened Steel, by *H. R. Letner,* University of Pittsburgh (Paper No. 54—A-56)

The Determination of Residual Stresses in Hardened Ground Steel, by *L. V. Colwell, M. J. Sinnott,* and *J. C. Tobin,* University of Michigan (Paper No. 54—A-52)

9:30 a.m.

Management (IV)—Production Engineering (I)

Industrial Applications for Linear and Nonlinear Programming[1]

Quadratic Programming of Independent Activities for Optimum Performance, by *L. E. Saline,* General Electric Co. (Paper No. 54—A-58)

Formal Models for Programming—Some Observations[1]

9:30 a.m.

Instruments and Regulators (I)

Predictor-Control Optimalizes Control-System Performance[1]

Slack Diaphragms[1]

9:30 a.m.

Heat Transfer (I)

Thermal Properties

Compressibility Deviations for Polar Gases[1]

Total Normal Emissivity Measurements on Aircraft Materials Between 100 F and 800 F[1]

Thermal Conductivity and Its Variability With Temperature and Pressure, by *L. S. Kowalczyk,* University of Detroit (Paper No. 54—A-90)

12:15 p.m.

Fuels Luncheon

Speaker: *Daniel P. Barnard,* Deputy Assistant Secretary of Defense for Research & Development, Washington, D. C.
Subject: **Evolving Patterns in Fuels and Energy**

12:15 p.m.

Nuclear Energy Luncheon

12:15 p.m.

Heat Transfer Luncheon

Toastmaster: *H. B. Nottage,* Project Manager, Propulsion Research Corp., Santa Monica, Calif.
Speaker: *Craig Taylor,* University of California
Subject: **Applications of Heat-Transfer Analysis to the Human Body**

2:30 p.m.

Applied Mechanics (V-A)

Elasticity II

Further Problems in Orthotropic Plane Stress, by *H. D. Conway,* Cornell University (Paper No. 54—A-48)

Stress Distribution in a Uniformly Rotating Equilateral Triangular Shaft, by *H. J. Johnson, Jr.,* Illinois Institute of Technology (Paper No. 54—A-91)

Solving Highly Complex Elastic Structures in Easy Stages, by *Gabriel Kron,* General Electric Co. (Paper No. 54—A-25)

On the Nonlinear Differential Equation for Beam Deflection,[1] by *E. J. Scott* and *D. R. Carver,* Kansas State College (Paper No. 54—A-35)

Application of the Electronic Differential Analyzer to the Oscillation of Beams, Including Shear and Rotary Inertia,[2] by *C. E. Howe,* Oberlin College; and *R. M. Howe,* University of Michigan (Paper No. 54—A-18)

Problems of Plant Elasticity for Reinforced Boundaries, by *J. R. M. Radok,* Aeronautical Research Laboratory, Melbourne, Australia (Paper No. 54—A-92)

2:30 p.m.

Applied Mechanics (V-B)—Heat Transfer (II)

Theory of Heat

Temperature Distribution and Efficiency of a Heat Exchanger Using Square Fins on Round Tubes, by *H. Zabronsky,* Ford Instrument Co. (Paper No. 54—A-12)

Laminar-Diffusion Boundary Layer—A Review, by *Kurt Berman,* General Electric Co. (Paper No. 54—A-29)

Heat-Transfer Measurements in an Inexpensive Supersonic Wind Tunnel[1]

2:30 p.m.

Aviation (IV)—Materials Handling (IV)—IAS (IV) SAE (IV)—NSIA (IV)—TAG (IV)

Rotary-Wing and Air-Cargo Handling

The Bell Model 61[1]

Military Cargo-Handling and Air-Pack Developments[1]

Marine Corps Helicopter Operations[1]

2:30 p.m.

Hydraulic (IV)

Cavitation Damage

Recent Investigations of the Mechanics of Cavitation and Cavitation Damage, by *Robert T. Knapp,* California Institute of Technology (Paper No. 54—A-106)

On the Mechanism of Cavitation Damage, by *M. S. Plesset,* California Institute of Technology, and *A. T. Ellis* (Paper No. 54—A-76)

Cavitation Pitting by Instantaneous Chemical Action From Impacts, by *Irving Taylor,* The Lummus Co. (Paper No. 54—A-109)

2:30 p.m.

Machine Design (IV)—Applied Mechanics (V-C)

Fatigue—The Problem and Some Solutions, by *G. R. Gohn,* Bell Telephone Laboratories (Paper No. 54—A-87)

A Theory of Fatigue-Damage Accumulation in Steel, by *D. L. Henry,* Wright-Patterson Air Development Center (Paper No. 54—A-77)

A Fatigue-Testing Machine Capable of Inducing Complex Stress-Time Relations in Its Specimens, by *W.L. Starkey* and *S. M. Marco,* Ohio State University (Paper No. 54—A-80)

2:30 p.m.

Oil and Gas Power (II)

General Technical Committee Meeting on Turbocharging of Two-Cycle Internal-Combustion Engines

Panel Members

L. Carletti, Brown-Boveri Corporation
C. A. Chamberlain, Clark Brothers
R. F. Miaskiewicz, Elliott Company
Rudolph Birmann, DeLeval Steam Turbine Company
Nelson Reed, Cooper-Bessemer Corporation

2:30 p.m.

Safety (II)—Production Engineering (II)

Industrial Noise and the Mechanical Engineer

Impact of Industrial Noise on the Economy of Industry[1]

Noise—What IT Is—How IT Acts[1]

Mechanical-Engineering Approach to Controlling Noise[1]

2:30 p.m.

Metal Processing (III)

The Effect of Wheelwork Conformity in Precision Grinding[1]

Shear-Plane Temperature Distribution in Orthogonal Cutting, by *J. H. Weiner,* Columbia University (Paper No. 54—A-65)

Dynamic Stability Criteria for Tool Vibration in Two Degrees of Freedom[2]

2:30 p.m.

Management (V)

Engineering Administration—What, How, and Why?[1]

Engineering Administration of the Factor of Safety in a Manufacturing Company[1]

Engineering Administration in a Small Company[1]

2:30 p.m.

Instruments and Regulators (II)

An Experimental Study of Two-Dimensional Gas Flow Through Valve-Type Orifices, by *A. H. Stenning,* Massachusetts Institute of Technology (Paper No. 54—A-45)

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[1] See box on page 855.
[2] Presented by title only.

A Method of Estimating Dynamic Characteristics of Physical Systems, by *Sidney Lees*, Massachusetts Institute of Technology (Paper No. 54—A-69)

2:30 p.m.

American Rocket Society (I-A)

Low-Temperature Components

Static Seal for Low-Temperature Fluids[1]

A New Helium-Refrigerated System for Production and Storage of Low-Boiling Propellants[1]

Hydrazine Logistics[1]

Static Seals for Missile Applications[1]

2:30 p.m.

American Rocket Society (I-B)

Combustion

Stabilized Flames in Turbulent Free Jets[1]

The Structure and Propagation Characteristics of Turbulent Flames in High-Speed Flow[1]

The Mechanism of Burning of Composite Solid Propellants[1]

Propagation of Flame Kernels and Turbulent-Flow Fluids[1]

2:30 p.m.

Power (IV)

Turbogenerators

Accuracy and Results of Steam-Consumption Tests on Medium Steam-Turbine-Generator Sets[1]

Experience in Testing Large Steam-Turbine Generators in Central Stations[1]

Close-Coupled Cross-Compound Arrangements for Compact Large Capability Steam-Turbine Generator Units[1]

High-Temperature Steam-Turbine Components

2:30 p.m.

Gas Turbine Power (III)

Recent Progress in Treatment of Residual Fuels[1] **for Gas Turbines**[1]

A 5000-Kw Railway-Mounted Gas-Turbine Power Plant[1]

5:00 p.m.

Roy V. Wright Lecture

Speaker: The Hon. *Thomas C. Desmond*, Senator, New York State

6:30 p.m.

Hydraulic Old Timers' Dinner

Presiding: *R. M. Watson*, Director of Research, The Worthington Corp., Harrison, N. J.

6:30 p.m.

Applied Mechanics Dinner

Presiding: *N. M. Newmark*, chairman, ASME Applied Mechanics Division; Research Professor, Structural Engineering, University of Illinois, Urbana, Ill.

8:00 p.m.

Management (VI)

The Engineering-Administrative Procedures in an Engineering Company[1]

Engineering Applied to Marketing[1]

8:00 p.m.

Instruments and Regulators (III)

A New Type of Orifice Flowmeter for Compressible Fluids[1]

A Study of Ambient-Temperature Effects on a Gas-Filled Thermal System for Pneumatic-Balance Instruments[1]

Backlash Considerations in Gear-Train Design[1] by *David D. Acker* and *A. H. Mach Meyer*, North American Aviation, Inc. (Paper No. 54—A-111)

8:00 p.m.

Power (V)

Boiler Developments

Superheater Metal-Temperature Evaluation, by *J. Parmakian* and *N. S. Sellers*, Riley Stoker Corp. (Paper No. 54—A-68)

Principles of Boiler Design for High Steam Temperatures[1]

Radiant Superheater Design and Experience[1]

Drum-Internals and High-Pressure Boiler Design[1]

8:00 p.m.

Production Engineering (III)—Machine Design (V)—Metal Processing (IV)—Materials Handling (V)

Automation

Automation—A Versatile Production Tool[1]

The Contribution of the Transfer Machine to Automation[1]

8:00 p.m.

Metals Engineering (I)

Some Properties of the Heat-Affected Zone in Arc-Welded Type 347 Stainless Steel, by *E. F. Nippes, H. Wawrousek*, Rensselaer Polytechnic Institute; and *W. L. Fleischmann*, Knolls Atomic Power Laboratory. (Paper No. 54—A-57)

Properties of High-Strength Stainless-Steel Weldments for Pressure-Shell Application[1]

Stress-Rupture Strength of Type-347 Stainless Steel Under Cyclic Temperatures[1]

WEDNESDAY, DECEMBER 1

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (VI)

Impact and Vibrations

Experimental and Theoretical Study of Transverse Vibration of a Tube Containing Flowing Fluid, by *R. H. Long, Jr.*, University of Maryland, (Paper No. 54—A-22)

An Approximate Theory of Lateral Impact on Beams, by *B. A. Boley*, Columbia University (Paper No. 54—A-24)

Forced Motions of Timoshenko Beams, by *George Herrmann*, Columbia University (Paper No. 54—A-6)

Plastic-Rigid Analysis of a Special Class of Problems Involving Beams Subject to Dynamic Transverse Loading,[2] by *Margaret F. Conroy*, Purdue University (Paper No. 54—A-17)

The Stress Problem of Vibrating Compressor Blades,[2] by *J. R. Schnitger*, The STAL Co., Finspong, Sweden (Paper No. 54—A-21)

9:30 a.m.

Aviation (V)—American Rocket Society (II-A)—IAS (V)—SAE (V)

An Introduction to the Thermal Problems of Turbojet Engines for Supersonic Propulsion

Supersonic Aircraft Propulsion[1]

Effect of Supersonic Flight on Power-Plant Installation System[1]

Melting of Bodies Due to Aerodynamic Heating[1]

9:30 a.m.

Hydraulic (V)

Compressor Theory and Design

Secondary Flow in Axial-Flow Turbomachinery[1]

A Method for Analyzing the Stresses in Centrifugal Impellers[1]

9:30 a.m.

Machine Design (VI)

Machine-Tool Automation, by *K. O. Tech*, The Cross Co. (Paper No. 54—A-82)

Influence of Automation on Machine-Tool Design, by *F. R. Swanson*, Sundstrand Machine Tool Co. (Paper No. 54—A-81)

Designing Dependability and Safety Into Transfer Machines, by *J. H. Mansfield*, Greenlee Brothers & Co. (Paper No. 54—A-78)

9:30 a.m.

Metal Processing (V)

Temperature Distribution at the Tool-Chip Interface, by *Kenneth J. Trigger* and *B. T. Chao*, University of Illinois (Paper No. 54—A-115)

Cutter Design and Application for Face-Milling Cast Iron and Steel, by *O. W. Boston*, University of Michigan; and *W. W. Gilbert*, General Electric Co. (Paper No. 54—A-51)

9:30 a.m.

Power (VI)

Different Types of Flue-Dust Collectors and Their Efficiency in Relation to Size and Types of Dust and the Characteristics of Dust

Characteristics of Fly Ash Affecting Collector Performance[1]

Some Factors Affecting Fly-Ash Collector Performance on Large Pulverized Fuel-Fired Boilers[1]

Steam-Piping Design to Minimize Concentrations

9:30 a.m.

Gas Turbine Power (IV)—Fuels (V)

Operating Experience With Units for Power Generation

Evaluation of Corrosion Resistance of Gas-Turbine Blade Materials[1]

The Influence of Some Chemical and Physical Factors on the Formation of Deposits From Residual Fuels[1]

9:30 a.m.

Heat Transfer (III)

Symposium: Economics of Heat-Exchanger Design and Operation

Approximate Methods for Selection, Sizing, and Pricing of Steam Surface Condensers, by *W. E. Ellingen*, Allis-Chalmers Mfg. Co. (Paper No. 54—A-127)

Economic Aspects of Shell and Tube Heat Exchangers, by *N. C. Beaton* and *P. A. Taxter*, The M. W. Kellogg Co. (Paper No. 54—A-128)

Optimum Design of Shell and Tube Heat Exchangers, by *M. J. Cichelli* and *M. Brinn*, E. I. du Pont de Nemours and Co., Inc. (Paper No. 54—A-125)

9:30 a.m.

Production Engineering (IV)—Management (VII)

Operations Research

Definition of Operations Research and General Outlook[1]

Operations Research and Its Application to Production Scheduling[1]

Operations Research and Its Application to Production Engineering[1]

9:30 a.m.

Metals Engineering (II)

Biaxial Plastic Stress—Strain Relation of a Mild Steel for Variable Stress Ratios

Effect of Sequence on the Coefficient of Friction in Cold-Drawing Low-Carbon Steel and 2S-O Aluminum Rods (Part 3),[1] by *Harry Majors, Jr.*, University of Alabama (Paper No. 54—A-114)

A Rational Analysis of Uniaxial Fatigue[1]

9:30 a.m.

American Rocket Society (II-B)

Testing

A Versatile Ignition-Delay Tester for Self-Igniting Rocket Propellants[1]

Dynamical Environmental Testing of Airborne Electronic Components[1]

A Method for Environmental Testing Rocket-Engine Systems and Components[1]

A Review of a New Water-Flow Check Facility for Rocket Engines[1]

9:30 a.m.

American Rocket Society (II-C)

Design

Some New Aspects of Liquid-Bipropellant Rocket-Engine Design[1]

Redundancy—The Snares and Delusions as a Design Concept[1]

Time-Dependent Strength of Materials[1]

Aerodynamic Design Problems of High-Altitude Rockets[1]

Simplifications of Rockets Through the Use of Multifunction Components[1]

12:15 p.m.

Honors Luncheon

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[1] See box on page 855.
[2] Presented by title only.

2:30 p.m.

Applied Mechanics (VII-A)

Elasticity and Vibrations

Gravitational Stresses in a Circular Ring Resting on Concentrated Support, by *Yi-Yuan Yu*, Washington University (Paper No. 54—A-7)

Harmonic Oscillations of Nonlinear Two-Degree-of-Freedom Systems, by *T. C. Huang*, International Harvester Co. (Paper No. 54—A-19)

Frictional Vibrations, by *David Sinclair*, Johns-Manville Research Center (Paper No. 54—A-46)

Application of Saint Venant's Principle in Dynamical Problems,[2] by *B. A. Boley* Columbia University (Paper No. 54—A-30)

2:30 p.m.

Applied Mechanics (VII-B)—Hydraulic (VI-A)

Fluid Dynamics and Plasticity

Two-Dimensional Flow About Half Bodies Between Parallel Walls, by *J. P. Breslin*, Gibbs & Cox, Inc. (Paper No. 54—A-3)

On Turbulent Jet Mixing of Two Gases at Constant Temperature, by *S. I. Pai*, University of Maryland (Paper No. 54—A-1)

Stress Distributions in Nonsymmetric Rotating Rays, by *P. G. Hodge, Jr.*, Polytechnic Institute of Brooklyn (Paper No. 54—A-96)

The Elastic-Plastic Stress Distribution Within a Wide Curved Bar Subjected to Pure Bending, by *B. W. Shaffer* and *R. N. House, Jr.*, New York University (Paper No. 54—A-94)

2:30 p.m.

Aviation (VI)—American Rocket Society (III-A)—IAS (VI)—SAE (VI)

Thermal Barrier: Effects on Equipment and Accessories

Equipment Problems in High-Speed Aircraft[1]

Personnel and Equipment Cooling in Supersonic Airplanes[1]

Human Problems Associated With High-Speed and High-Altitude Flight[1]

2:30 p.m.

Hydraulic (VI-B)

Topics in Fluid Dynamics

The Mechanism of Cavitation Inception and the Related-Scale-Effects Problem[1]

Turbulent Flow at the Entrance Region of a Pipe, by *D. Ross* (Paper No. 54—A-89)

An Experimental and Analytical Investigation of a Differential Surge-Tank Installation[1]

2:30 p.m.

Power (VII)

Effect of Stack Heights on Gas Dispersion

Prediction of Ground Concentrations Resulting From the Emission of Stack Gases[1]

Economic Considerations in Determining Stack Costs in Relation to Height[1]

2:30 p.m.

Gas Turbine Power (V)

Operating Experience on General-Electric Gas Turbines[1]

The Development of the First Gas-Turbine Mechanical-Drive Locomotive[1]

2:30 p.m.

Heat Transfer (IV)

Symposium: Economics of Heat-Exchanger Design and Operation

Feedwater Heaters—A User's Viewpoint, by *S. M. Arnow*, Philadelphia Electric Co. (Paper No. 54—A-129)

The Economics of Heat-Exchanger Design[1]

Optimum Heat Transfer for Minimum Thermal Stress in Nuclear-Reactor Shells, by *F. P. Durham*, University of Colorado (Paper No. 54—A-126)

2:30 p.m.

Production Engineering (V)—Management (VIII)

Quality Improvement

Inspection Procedures for the Acceptance or Rejection of Incoming Steel Shipments[1]

Interpretation of Ultrasonic Tests Through the Use of Statistical Quality-Control Techniques[1]

The Application of Statistical Techniques to Simple Fixed Gage Design[1]

2:30 p.m.

Metals Engineering (III)

The Significance of Strain as the Mechanism in Thermal-Fatigue Behavior[1]

Quantitative Evaluation of Thermal-Shock Resistance[1]

Approximate Solution to Thermal-Stress Problems in Hollow Cylinders With Heat Transfer at Outer and Inner Radii[1]

2:30 p.m.

American Rocket Society (III-B)

Rockets

Track-Borne Test Vehicles[1]

Supersonic Component-Test Missile[1]

Structural Feedback on the Viking Rocket[1]

Development of a Stabilization System for Viking Rockets[1]

Supersonic Research Sleds and Track Facilities[1]

Performance Analysis of Short-Range, High-Velocity Ballistic Rockets[1]

2:30 p.m.

American Rocket Society (III-C)

Design

Pumping Hydrogen Peroxide[1]

A General Enthalpy—Enthropy-Temperature Diagram for Gases and Mixtures Thereof and Some Applications in Rocket Thermodynamic Calculations[1]

A Method of Determining the Unidirectional Transient Heat Flow at a Gas-Metal Interface Applied to a 40-Mm Gun Barrel[1]

Vibration Program[1]

Which Way Is Up?[1]

Flow Separation in Supersonic Nozzles[1]

2:30 p.m.

Railroad (III)—Fuels (VI)

N.&W. Coal-Fired Steam-Turbine-Electric Locomotive (Descriptive)[1]

N.&W. Coal-Fired Steam-Turbine-Electric Locomotive (Performance)[1]

7:00 p.m.

Banquet

Speaker: *J. R. Dunning*, Dean of Engineering, Columbia University, New York, N. Y.

10:00 p.m.

President's Reception

THURSDAY, DECEMBER 2

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (VIII-A)

Elastic Stability

Buckling of Continuous Columns, by *H. C. Perkins*, Cornell University (Paper No. 54—A-32)

Lateral Buckling of Asymmetrical Beams, by *H. L. Langhaar*, University of Illinois (Paper No. 54—A-99)

A Refinement of the Theory of Buckling of Rings Under Uniform Pressure, by *A. P. Boresi*, University of Illinois (Paper No. 54—A-2)

9:30 a.m.

Aviation (VII)—American Rocket Society (IV-A)—IAS (VII)—SAE (VII)—Applied Mechanics (VIII-B)

Thermal Barrier: Effects on Aircraft Structures

The Thermal Barrier—Structures[1]

Some Structural Aspects of Thermal Flight, by *George Gerard*, New York University (Paper No. 54—A-40)

Problems in the Design of Aircraft Subjected to High Temperature, by *F. R. Steinbacher* and *L. Young*, Lockheed Aircraft Corp. (Paper No. 54—A-100)

9:30 a.m.

Power (VIII)

Industrial Power Plants

The Dual-Circulation Boiler in Industrial-Power Plants[1]

Operating Experience With Dual-Circulation Boilers Using 100 Per Cent Make-Up[1]

CO Boiler and Fluidized-Bed Steam Superheater on Sinclair Refining Company's New Fluid Unit at the Houston Refinery, by *O. P. Campbell* and *N. E. Pennels*, Sinclair Refining Co. (Paper No. 54—A-20)

9:30 a.m.

Gas Turbine Power (VI)

Structural Design Problems in Gas-Turbine Engines[1]

Gas-Turbine Bucket Operating Experience and Bucket and Wheel-Design Method[1]

9:30 a.m.

Heat Transfer (V)

Exchanger Theory

Perturbation Solutions for the Periodic-Flow Thermal Regenerator, by *L. L. Jones, Jr.*, and *D. H. Fax*, Westinghouse Electric Corp. (Paper No. 54—A-130)

Hydraulic Analogy for Multipass Crossflow Heat Exchangers[1]

Measurement of Mean-Fluid Temperatures[1]

9:30 a.m.

Metal Processing (VI)

Plastic Working of Metals—Introduction to Panel Discussion, by *W. S. Wagner*, E. W. Bliss Co. (Paper No. 54—A-64)

Panel Discussion on Plastic Working of Metals

9:30 a.m.

American Rocket Society (IV-B)

Combustion

Further Combustion Studies in Rocket Motors[1]

A Monograph on the Problem of Combustion Instability in Liquid-Propellant Rocket Motors[1]

Relationship Between Fluid Dynamics and Combustion as Indicated by an Opposing Jet in Turbulent Flow[1]

Experimental and Theoretical Studies in Heterogeneous Combustion[1]

9:30 a.m.

American Rocket Society (IV-C)

Space Flight

The Incremental Step Rocket in Free Space[1]

A Suggested Trajectory-Control System for a Satellite-Rocket Vehicle[1]

Preliminary Design Study for a Three-Stage Satellite Rocket Embodying Piloted Recoverable Stages[1]

The Role of Rocket Aircraft in High-Altitude Research[1]

9:30 a.m.

Railroad (IV)

Free-Piston Gas-Turbine Prime Movers—A Review of Basic Principles, by *A. J. Ehrat*, Baldwin-Lima-Hamilton Corp. (Paper No. 54—A-67)

Possibilities of Burning Cheaper Fuels in Diesel Locomotives[1]

9:30 a.m.

Materials Handling (VI)

Equipment for Automation—The Automatic Tong[1]

9:30 a.m.

Rubber and Plastics (I)

Shock Isolators

Symposium: Vibration and Impact Isolators

The Effect of Pulse Shape on Simple Systems Under Impulsive Loading[1]

Determination of Shock-Isolator Performance, by *J. P. Walsh* and *R. F. Blake*, Naval Research Laboratories (Paper No. 54—A-39)

Impact and Longitudinal-Wave Transmission, by *E. A. L. Smith*, Raymond Concrete Pile Co. (Paper No. 54—A-42)

12:15 p.m.

Members and Students Luncheon

2:30 p.m.

Applied Mechanics (IX)

Plate Theory

Bending of Orthogonally Stiffened Plates, by *W. H. Hoppmann, 2nd*, Johns Hopkins University (Paper No. 54—A-31)

[1] See box on page 855.
[2] Presented by title only.

Axially Symmetric Flexural Vibrations of a Circular Disk[1]

The Effect of Elliptic Holes on the Bending of Thick Plates, by *P. M. Naghdi*, University of Michigan (Paper No. 54—A-26)

Stresses Due to Diametral Forces on a Circular Disk With an Eccentric Hole, by *A. M. Sen Gupta*, Bengal Engineering College, West Bengal, India (Paper No. 54—A-37)

The Root Section of a Swept Wing—A Problem of Plane Elasticity, by *B. C. Hoskin* and *J. R. M. Radok*, Aeronautical Research Laboratory, Melbourne, Australia

2:30 p.m.

Aviation (VIII)

Turbojet Components

Problems in Evaluation and Maintenance of Jet-Engine Fuel-Metering Accessories, by *L. A. Wilson*, Bureau of Aeronautics, Navy Department (Paper No. 54—A-70)

Computer-Controlled Hydraulic Drive for Engine Simulation[1]

2:30 p.m.

Power (IX)

Marine Session

Four Years' Stationary Operation of Marine Boilers[1]

An Industrial Application of Marine-Type Power Plant[1]

Marine-Boiler Operating Experience—Salt River Power District[1]

Marine Boilers in Stationary Service—Number, Types, and Pertinent Operating Characteristics[1]

2:30 p.m.

Gas Turbine Power (VII)

Gas-Turbine Exhaust-Heat Recovery[1]

Experimental Cooling of a Radial-Flow Turbine[1]

A Method of Aerothermodynamic Design of Multistage Reaction Turbines[1]

2:30 p.m.

Heat Transfer (VI)

Boundary Layer

Experimental Determination of the Thermal Entrance Length for the Flow of Water and of Oil in Circular Pipes[1]

Turbulent Heat Transfer and Friction in the Entrance Regions of Smooth Passages[1]

An Approximate Solution of Compressible Turbulent Boundary-Layer Development and Convective Heat Transfer in Convergent Divergent Nozzles[1]

2:30 p.m.

Metal Processing (VII)

Stresses and Strains in Cold-Extruding 2S-O Aluminum[1]

A Re-Evaluation of Surface Finish[1]

2:30 p.m.

American Rocket Society (V)

Panel: Space Flight

2:30 p.m.

Railroad (V)

Realistic Goals for Railway Passenger-Car Design, by *T. C. Gray*, Pullman-Standard Car Manufacturing Co. (Paper No. 54—A-49)

Heavy-Capacity Freight Cars[1]

2:30 p.m.

Materials Handling (VII)

Design of Materials-Handling Machine—the Load-O-Mat[1]

Plant-Layout Problems[1]

2:30 p.m.

Rubber and Plastics (II)—Machine Design (VII)

Vibration Isolators

Experimental Technique for Predicting Dynamic Properties of Rubbers, by *R. C. Dove* and *Glenn Murphy*, Iowa State College (Paper No. 54—A-41)

Vibration—Shock Control—A Design Tool[1]

Engineering Aspects of Rubber Progress, June, 1953—August, 1954[1]

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[1] See box on page 855.
[2] Presented by title only.

2:30 p.m.

Boiler Code (II)

Endurance Testing of Expansion Joints, by *Walter Samans*, consulting engineer, and *Leo Blumberg*, Pennsylvania Military College (Paper No. 54—A-103)

Stresses From Radial Loads in Cylindrical Pressure Vessels, by *P. P. Laard*, Cornell University (Paper No. 54—A-191)

The Design of Vertical Pressure Vessels Subjected to Applied Forces, by *Elmer O. Bergman*, C. F. Braun and Co. (Paper No. 54—A-104)

Procedure Used for Selecting Stress Values for the ASME Unfired Pressure Vessel Code[1]

7:00 p.m.

American Rocket Society Honors Dinner

8:00 p.m.

Heat Transfer (VII)

Forced Convection

The Influence of Curvature on Heat Transfer to Incompressible Fluids, by *Frank Kreith*, Lehigh University (Paper No. 54—A-55)

Heat Transfer and Pressure Drop for Viscous Turbulent Flow of Oil-Air Mixtures in a Horizontal Pipe[1]

Heat-Conduction Methods in Forced-Convection Flow[1]

8:00 p.m.

Effect of Temperature on Metals

Carbon-Molybdenum Steel Steam Pipe After 100,000 Hours of Service, by *R. J. Sinnott, I. A. Rohrig*, Detroit Edison Co.; and *J. W. Freeman, A. I. Rush*, University of Michigan (Paper No. 54—A-73)

Investigations Into Blade-Root Fixings of High-Temperature Steels[1]

The Effect of Stress Concentration on the Fatigue of N-155 Alloy at Elevated Temperatures[1]

The Effect of Notches on the Rupture Strength of Heat-Resistant Alloys at Elevated Temperatures[1]

Properties of Cast Iron at Elevated Temperatures—A Progress Report[1]

FRIDAY, DECEMBER 3

8:00 a.m.

Registration

8:15 a.m.

Inspection Trip: United States Steel Corp., Fairless Works, and Power Show

9:30 a.m.

Heat Transfer (VIII)

Evaporation and Boiling

Droplet Evaporation in a High-Temperature, Turbulent Gas Stream[1]

On the Evaporation of a Drop of Volatile Liquid in High-Temperature Surroundings[1]

Remarks on the Mechanism and Stability of Surface-Boiling Heat Transfer[1]

The Network Method of Radiation Analysis, by *A. K. Oppenheim*, University of California (Paper No. 54—A-75)

9:30 a.m.

Materials Handling (VIII)

General Engineering Problems on Materials Handling[1]

General Engineering in Grain Bulk Handling[1]

9:30 a.m.

Rubber and Plastics (III)—Machine Design (VIII)

Symposium: Engineering Properties of Plastics Materials

Precision Control of Injection-Molding Pressure[1]
Considerations in the Design of Plastic Structures for Light Weight[1]

The Use of the Repeated Hysteresis Loop for the Evaluation of Reinforced Plastic Materials and Structures[1]

Molding Reinforced Plastics With Low-Cost Cores[1]

9:30 a.m.

Professional Practice of Consulting Engineering

Criteria in Selecting Consulting Engineers[1]

9:30 a.m.

Process Industries (I)

Air Conditioning

Air Conditioning Large Office Structures[1]
Design Factors in Air Conditioning
Air Conditioning of Large Office Structures

9:30 a.m.

Textile Engineering (I)

Winding

Filament Yarns[1]
Knitting[1]

12:15 p.m.

Textile Engineering Luncheon

Presiding: *L. A. Runton*, Director of Engineering, Alexander Smith, Inc., White Plains, N. Y.

2:30 p.m.

Textile Engineering (II)

Filling[1]
Winding for Package Dyeing[1]

2:30 p.m.

Heat Transfer (IX)

Effect of Vapor Velocity on Laminar and Turbulent Film Condensation[1]

Heat Transfer and Temperature Distribution in Laminar Film Condensation[1]

Numerical Solutions for Laminar-Flow Heat Transfer in Circular Tubes[1]

An Interferometric Study of Free-Convective Heat Transfer From Enclosed Isothermal Surfaces[1]

Free-Convection Heat Transfer From a Rotating Horizontal Cylinder to Ambient Air, With Interferometric Study of Flow,[2] by *G. A. Etamad*, University of Buffalo, (Paper No. 54—A-74)

2:30 p.m.

Materials Handling (IX)

Materials-Handling Research and Development Projects[1]

Materials-Handling Report to British Engineering Societies[1]

2:30 p.m.

Rubber and Plastics (IV)—Aviation (IX)

Symposium: Engineering Properties of Plastic Materials

Recognizing Applications for Reinforced Plastics[1]
Plastic-Covered Antennas Improve Radio Performance[1]

Review of Plastics Developments in 1953-1954[1]

2:30 p.m.

Process Industries (II)

Spray Drying

The General Area of Spray Drying[1]
Spray Drying in the Dairy Industry[1]

WOMEN'S PROGRAM

Woman's Auxiliary to the ASME

Mrs. Charles M. Hickox, President

Mrs. U. A. Rothermel, Annual Meeting General Chairman

Mrs. Erik Oberg, Annual Meeting General Vice-Chairman

Monday, Nov. 29, through Thursday, Dec. 2

Registration for Women — *Registrars:* Mrs. Crosby Field, Mrs. H. R. Kessler, Mrs. R. W. Oakley

Sunday, November 28

4:00 p.m. to 7:00 p.m.

Social Hour for all ASME men and women. The Town Hall Club, 123 West 43rd Street — *Co-chairmen:* Mrs. R. W. Cockrell, Mrs. W. H. Byrne

Monday, November 29

10:00 a.m. to 11:00 a.m.

Coffee Hour — *Co-chairmen:* Mrs. Marie Michal, Mrs. G. A. Harman

12:00 Noon

President's Luncheon The women are invited to join the men at this luncheon, Hotel Statler	*Chairman:* Mrs. C. M. Hickox

4:00 p.m. to 7:00 p.m

Tea Dance For all men and women of ASME, Hotel Statler	*Co-chairmen:* Mrs. W. E. Case Mrs. R. B. Purdy

7:30 p.m.

Night Club Tour Dinner and show at Latin Quarter; Show at Chateau Madrid	*Co-chairmen:* Mrs. H. F. Smiddy Mrs. G. R. Hahn

Tuesday, November 30

8:30 a.m.

National Board Breakfast followed by National Board Meeting, Hotel Statler	*Co-chairmen:* Mrs. Sabin Crocker Mrs. A. R. Cullimore

11:00 a.m.

Tour of Dan Cooper, Inc. Talk by Mr. Cooper on interior decoration, 30 Rockefeller Plaza	*Co-chairmen:* Mrs. A. L. Jordan Mrs. N. W. Wyckoff

12:30 p.m.

Annual Luncheon and Fashion Show, "Preview of 1955" under direction of Countess Denise Dolfin. Cotillion Room, Hotel Pierre	*Chairman:* Mrs. J. C. Gibb *Co-chairmen:* Mrs. H. F. Smiddy Mrs. A. J. Turpin

8:30 p.m.

Coffee Hour "Arabia" — colored slides narrated by Karl Twitchell, just returned from the Middle East	*Co-chairmen:* Mrs. F. S. Mallette Mrs. D. V. Minard

Wednesday, December 1

10:00 a.m.

Annual Meeting, Woman's Auxiliary	Mrs. C. M. Hickox, President, presiding

12:30 p.m.

Stork Club Luncheon. Lingerie show by Vanity Fair	*Co-chairmen:* Mrs. H. R. Kessler Mrs. Erik Oberg

12:30 p.m. (Alternate)

Luncheon and Tour. Metropolitan Museum of Art	*Co-chairmen:* Mrs. R. B. Skinner Mrs. T. A. Burdick

7:00 p.m.

Annual Banquet, Reception, and Dance. Hotel Statler

Thursday, December 2

10:30 a.m.

Tactile-Painting Demonstration. Talk on hobbies, "Stay Alive as Long as You Live," by Helen J. McRae.	*Co-chairmen:* Mrs. Milton Gershon Mrs. J. J. Moro-Lin

1:00 p.m.

Luncheon, New York Times Restaurant. Newspaper tour, *New York Times*	*Co-chairmen:* Mrs. W. F. Friend Mrs. G. W. Nigh

Special-Events Program Planned for Power Show

A SERIES of special events is being planned in conjunction with the Twenty-First National Exposition of Power and Mechanical Engineering at Philadelphia, Pa., December 2 to 7. On the program will be papers and discussions of interest to visiting engineers attending the 1954 Annual Meeting, Nov. 28–Dec. 3, at the Hotel Statler, in New York, N. Y., of The American Society of Mechanical Engineers, under whose auspices the exposition in Philadelphia's Commercial Museum will be held.

Fairless Works Inspection

Of particular interest to ASME members will be plans now being developed for an inspection trip from the Annual Meeting in New York to the Power Show via the Fairless Works of U. S. Steel Corporation on Friday, December 3. On Monday, December 6, there will be a joint meeting and dinner of the Philadelphia Section of the ASME and the American Society of Civil Engineers.

Symposium on Automation

Another timely event will be an all-day symposium on Automation to be held by the Instrument Society of America, December 3, covering such topics as "Trends," "New Problems Created by Automation," "Automatic Intelligence Gathering Systems," and an analysis of "The Engineering Control Loop." Another event already announced is a dinner meeting of the Plant Engineers Club of Greater Philadelphia, to be held at the show Thursday, December 2.

"First-Time" Exhibits

A sampling of specifications for first-time exhibits includes an "Autolog" which records operating performances at as many as 50 trouble points in plant operation, an electric boiler of British origin, and a noteworthy new exhibit described as affording a more lucid presentation of the advantages of seamless manufacture of steel pipe and tubes.

Displayed with the Autolog will be a supersensitive gas detector which makes possible for the first time accurate sensing of toxic or combustible gases in concentrations as extremely low as five parts per billion. This instrument depends in principle on the detection of mercury vapor in ultraviolet light—termed the most sensitive method of analysis known. The continuous model is suitable for indicating air pollution, for industrial toxic-gas control, flue-gas analysis, and other applications. A modified instrument may be used for quantitative measurement of ultraviolet absorbing materials, such as benzene, methanol, aromatic hydrocarbons, and water vapor.

From an English source will come the first United States exhibit of a line of high-grade electric motors, built to NEMA as well as British standards. Several new automatic variable-speed electric motor drives will be exhibited, at least two of which employ pneumatic means of regulation. One pneumatic control operating under 60 to 100 psi, is positively positioned by a piston having both sides under working pressure and regulated by a pilot valve under 3 to 15 psi signal pressure. This system not only permits remote manual-speed control, but offers regulation of a variety of dependent speed functions, to maintain speed constant with, or proportional to, pressure—or speed regulation with respect to temperature, liquid level, rate of flow, or even conveyer delivery of dry materials.

One exhibitor will reveal a patented line of co-ordinated pumps and motors which offer new possibilities in the transmission of power through hydraulics. Up to three motors may be driven from a single pump, the motors affording high torque and high horsepower. A selector valve provides complete speed variation and control from the positive-displacement pump.

A series of newly designed plug-in control centers for power distribution in industrial plants and commercial buildings; innovations in the illumination of work centers; and a new line of socket-type welded pipe fittings, which includes joints for tubing, will be among the several "first" to be disclosed at the show.

Model Gas Turbines

Model gas turbines, a cutaway steam turbine, a new line of electric motors, a line of fans and blowers, as well as unit heaters, will be shown by another manufacturer. As an important feature, this exhibit will be staffed by engineers, available to discuss with visitors the broader aspects of gas or steam-turbine problems, air-handling questions, electric-motor and control apparatus.

An innovation at the exposition destined to interest public-utility and power-station operators, as well as manufacturers and users of electric motors, generators, transformers, cables, insulators, and all types of electrical equipment, is the first comprehensive line of instruments designed specifically for d-c over-potential testing.

Among items of special interest to be exhibited is a motor-rotation and phase tester for determining the direction of rotation of electric motors before putting them on the line, and also to determine the phase rotation or sequence of energized power circuits before cutting in equipment. There will be also a new temperature monitor for central stations, chemical processing, or heavy machinery; positive acting, without need for scanning; versatile, and "maintenance free." There are, from still another source, a new time-delay relay, adjustable between $\frac{1}{2}$ and 6 sec lag, and an engine-generator control that starts or stops the engine when the electrical load is cut in or cut out.

An established manufacturer of packaged boilers will show for the first time a boiler that is new in design and construction, introduced just this year. It is smaller in size than its predecessors, but with four-pass construction, affords five sq ft of heating surface per boiler, assuring a minimum guaranteed efficiency of 80 per cent. Another exhibitor showing a line of "steam-power packages" will feature a mercury-filled thermostat "unlike any other," which is not only accurate, but vibration-resistant. Nor will visitors especially interested in steam fail to note a new tube expander with taper rolls of proper length to roll tubes closely spaced in thin tube sheets, as in packaged boilers.

ASME Calendar of Coming Events

Oct. 28–29
ASME-AIME Joint Fuels Conference, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers was June 1, 1954)

Nov. 28–Dec. 3
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers was July 1, 1954)

Feb. 16, 1955
The Founding Anniversary Meeting, McGraw-Hill Building, New York, N. Y.
(No formal papers will be presented)

March 23–24, 1955
ASME Management Conference, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers—Nov. 1, 1954)

April 16, 1955
The Organization Anniversary Meeting, Stevens Institute of Technology, Hoboken, N. J.
(No formal papers will be presented)

April 18–21, 1955
Diamond Jubilee Spring Meeting, Lord Baltimore Hotel, Baltimore, Md.
(Final date for submitting papers—Dec. 1, 1954)

April 25–26, 1955
ASME Instruments and Regulators Conference, University of Michigan, Ann Arbor, Mich.
(Final date for submitting papers—Dec. 1, 1954)

June 5–10, 1955
ASME Oil and Gas Power Conference, Statler Hotel, Washington, D. C.
(Final date for submitting papers—Feb. 1, 1955)

June 15–17, 1955
ASME and The Institution of Mechanical Engineers, London, England, Joint Conference on Combustion, Massachusetts Institute of Technology, Cambridge, Mass.
(Final date for submitting invited papers—Nov. 1, 1954)

June 19–23, 1955
Diamond Jubilee Semi-Annual Meeting, Hotel Statler, Boston, Mass.
(Final date for submitting papers—Feb. 1, 1955)

Sept. 12–16, 1955
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Los Angeles, Calif.
(Final date for submitting papers—May 1, 1955)

Sept. 25–28, 1955
ASME Petroleum-Mechanical Engineering Conference, Jung Hotel, New Orleans, La.
(Final date for submitting papers—May 1, 1955)

Nov. 13–18, 1955
Diamond Jubilee Annual Meeting, Hotel Congress, Chicago, Ill.
(Final date for submitting papers—July 1, 1955)

AIF Preparing Survey of Industry's Needs

The Atomic Industrial Forum has recently initiated a survey of the types of materials, equipment, and skills most likely to be required by the atomic-energy industry during the next few years, together with an analysis of the magnitude of the demand for each. The Forum entered into a study agreement with the U. S. Atomic Energy Commission to facilitate the conduct of the survey.

The survey is divided into three sections, private nuclear research and development, radiation-instrument manufacture, and reactor development. Data on the first two sections is being obtained via questionnaires which have been mailed to 1000 institutions (including 75 radiation-instrument manufacturers) active in or interested in the private development of atomic energy and its by-products. This information will be supplemented by interviews with selected industrial firms known to be active in the field. The reactor-development section of the survey will be handled through a review of background information in AEC files, through interviews with contractors responsible for AEC's five-year reactor-development program, and various participants of AEC's industrial-participation program.

The study team is made up of Frederick Warren of General Dynamics and formerly deputy director of AEC's division of construction and supply, James Pickard, a private consultant in atomic-energy developments and formerly with AEC's division of reactor development, and Edwin Wiggin, Forum manager of technical information and formerly with AEC's isotopes division.

Mechanical-Engineering Curriculum to Be Topic at Clarkson College Meeting

"Trends in Mechanical-Engineering Curriculum" will be thoroughly scrutinized by outstanding engineers and educators when The American Society of Mechanical Engineers and The Engineering Institute of Canada meet at Clarkson College of Technology, Potsdam, N. Y., on October 6–8.

In announcing the participants in the convocation program, William G. Van Note, president of the host college, said, "The present transcendent importance of engineering education led these two engineering societies to accept Clarkson College's invitation to examine closely the trends in mechanical-engineering education."

The national presidents of the two societies will speak at the banquet, to be held October 7 in Lewis House, the college union. They are Donald M. Stephens, EIC President, and Lewis K. Sillcox, ASME President.

Moderating the first session, entitled "Can Present Mechanical-Engineering Curricula Be Improved?" will be Thomas D. Jolly, Fellow ASME, vice-president of the Aluminum Company of America, Pittsburgh, Pa. The speakers on this topic will be R. J. Askin, vice-president, Abitibi Power and Paper Company, Ltd., Toronto, Ont.; E. G. Bailey, past-president and Fellow ASME, chairman of the board, Bailey Meter Company, Cleveland Ohio; Edgar A. Allcut, Mem. ASME, professor of mechanical engineering, faculty of applied science and engineering, University of Toronto; and C. Richard Soderberg, Fellow ASME, dean of engineering, Massachusetts Institute of Technology.

A panel discussion of the same topic will be undertaken by Henry Gaudefroy, dean of engineering, École Polytechnique, Montreal, Que., Can.; George B. Thom, Mem. ASME, chairman, department of mechanical engineering, Newark College of Engineering, Newark, N. J.; N. H. Meixner, Mem. ASME, assistant director, machine-development section, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del.; and D. C. R. Miller, director and general manager, Dow Chemical Silicones, Ltd., Toronto, Ont., Can.

Alexander G. Christie, past-president and Hon. Mem. ASME, professor-emeritus of mechanical engineering, Johns Hopkins University, will moderate a session entitled "Dangers of Overspecialization in the Curriculum." Among the speakers will be Donald L. Mordell, Mem. ASME, professor and chairman, department of mechanical engineering, McGill University, Montreal; R. S. Spoule, manager, hydraulic department, Dominion Engineering Works, Ltd., Montreal; Jess H. Davis, Mem. ASME, president, Stevens Institute of Technology; and Karl B. McEachron, Jr., Mem. ASME, major appliance division, General Electric Co., Erie, Pa.

William A. MacIntosh, principal and vice-chancellor, Queens University, Kingston, Ont., will preside at the closing dinner, Friday, October 8. At that time, Dean D. L. Thompson of the graduate study and research divison, McGill University, will speak about "The Postgraduate Education in Engineering."

17th ASME-AIME Fuels Conference, Oct. 28-29, to Be Held in Pittsburgh

The annual Fuels Conference of the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers, with the co-operation of the Pittsburgh Sections of both societies, will be held at the William Penn Hotel, Pittsburgh, Pa., October 28-29, 1954.

The 1954 joint conference is the seventeenth of a series of such meetings which began in 1937 to provide a coal-users' and producers' forum to discuss the problems encountered in their operations and to report the latest innovations instituted by the industry during the preceding year.

The tentative program follows:

THURSDAY, OCTOBER 28

8:30 a.m. — Seventeenth Floor

Registration

All members and guests are requested to register before entering the session room. Registration fee is $3.

10:00 a.m. — Urban Room

Technical Session

Small and Medium-Sized Applications of the Cyclone Furnace, by *W. I. Collins,* The Babcock & Wilcox Co., Pittsburgh, Pa.

Traveling Grate-Application Experience With Strong Coking Coals, by *J. M. MacLachlan,* Pittsburgh Consolidation Coal Co., Library, Pa.

12:30 p.m. — Terrace Room

Luncheon Meeting

Speaker: *L. K. Sillcox,* President, ASME
Subject: **The ASME**
Speaker: *L. F. Reinartz,* President, AIME
Subject: **The AIME**

Technical Session

Progress Report: Bureau of Mines Estimate of Coking-Coal Reserve, by *J. J. Dowd,* chief, Bituminous Coal Mining Branch, U. S. Bureau of Mines, Pittsburgh, Pa.

Coking Properties of Pittsburgh District Coals, by *F. W. Smith,* chief, Coal Carbonization Section, U. S. Bureau of Mines, Pittsburgh, Pa.

Selection of Coals for Coking, by *A. H. Brisse*, chief research engineer, Coal and Coke, and *J. H. Wells*, research associate, Applied Research Laboratory, U. S. Steel Corp.

4:00 p.m. Parlor "B"
Executive Committee, Fuels Division, ASME

4:00 p.m. Parlor "C"
Executive Committee, Coal Division, AIME

4:30 p.m. Parlors "B" and "C"
Joint Conference Committee Meeting

6:30 p.m. Sky Room

Cocktail Hour

7:00 p.m. Urban Room

Banquet

Presiding: *T. E. Purcell*, general chairman, 1954 Fuels Conference Committee

Toastmaster: *P. H. McCance*, president, The Dusquesne Light Co., Pittsburgh, Pa.

Speaker: *R. L. Ireland*, chairman, Executive Committee, Pittsburgh Consolidation Coal Co., Cleveland, Ohio

Subject: **A Look From Within the Coal Industry**
Presentation of Percy Nicholls Award for 1954

FRIDAY, OCTOBER 29

The technical sessions, the luncheon, the cocktail hour, and the dinner on this day have been arranged by, and are under the sponsorship of, the Pittsburgh Section of the American Institute of Mining and Metallurgical Engineers.

This one-day meeting is one of a series of such meetings which have been held over the years and are known as "Off the Record" meetings.

Those who have registered for the Joint Fuels Conference are invited to attend all of the functions on this day.

10:00 a.m. Pittsburgh Room
Technical Session

Air-Pollution Problems With Heat Drying of Fine Coal, by *C. W. Gordon*, Combustion Engineering, Inc., Chicago, Ill.

Problems Encountered With Industrial Waste Water, by *H. F. Hobley*, Pittsburgh Consolidation Coal Co., Pittsburgh, Pa.

12:30 p.m. Ballroom

Luncheon

2:00 p.m. Pittsburgh Room
Technical Session

Symposium: The Operation of Continuous Mining Machines in the Tri-State Area
Several up-to-date papers reciting operating experiences with various makes of continuous mining machines under a variety of steam conditions as encountered in Ohio, Pennsylvania, and West Virginia.

5:45 p.m. Urban Room

Cocktail Hour

7:00 p.m. Ballroom

AIME Fellowship Dinner

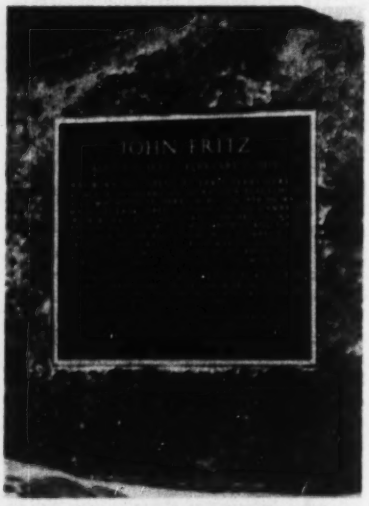
Chairman: *M. H. Forester*, Pittsburgh Consolidation Coal Co., Pittsburgh, Pa.
Co-chairman: *C. B. Tillson*, Crucible Steel Co. of America, Rice's Landing, Pa.
Speaker: *R. G. Fithian*, Bell Telephone Co., Pittsburgh, Pa.
Subject: **Bell Telephone Company's Development of the Transistor**

Historical Society Pays Tribute to John Fritz

SATURDAY, August 21, 1954, was the 132nd anniversary of the birth of John Fritz. Appropriately, under the auspices of the Chester County Historical Society (West Chester, Pa.), a permanent marker was unveiled, indicating the birthplace of John Fritz in Londonderry Township, Chester County. The original sturdy log house, now covered with clapboards, is in excellent condition and is tenanted.

This dedication was a part of the annual Pilgrimage made by the society and brought well over a hundred interested spectators. Arthur E. James, president of the society, introduced John Fritz Hartshorne, great-grandnephew of John Fritz, who briefly reviewed the accomplishments and philosophies of this great pioneering personality, then removed the covering to reveal a magnificently conceived and executed bronze plate, 24 in. × 30 in., set in a field boulder, between the house and the highway. This marker is the gift of the Bethlehem Steel Company; in the early days of the company it was known as the Bethlehem Iron Company. John Fritz was general superintendent and chief engineer—from 1860 until his retirement in 1892 at the age of 70 years. The inscription reads:

Officiating at the unveiling of the marker, August 21, showing where John Fritz was born, are Arthur E. James, *facing marker*, president, Chester County Historical Society, and, *standing back of marker*, John Fritz Hartshorne, great-grandnephew of the steel pioneer and past-president of ASME



Shown is the marker, which indicates where John Fritz was born 132 years ago. It is a beautifully executed bronze plaque, 24 in. × 30 in., set in a field boulder. It is the gift of the Bethlehem Steel Company. John Fritz was employed as general superintendent and chief engineer, when the company was known as Bethlehem Iron Company.

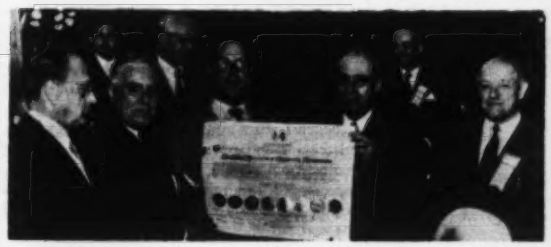
JOHN FRITZ

August 21, 1822–February 13, 1913 was born and spent his early years here. At age 16 he became an apprentice blacksmith and machinist in Parkesburg. In 1854 he was made general superintendent of the Cambria Iron Works at Johnstown. In 1860 he was appointed general superintendent and chief engineer of the Bethlehem Iron Company. He designed and erected iron-making facilities at Bethlehem which in 1863 were among the largest and most complete in the world. His inventive genius and practical resourcefulness made him one of the world's outstanding figures in the 19th century history of the iron and steel industry. This marker, given by the Bethlehem Steel Company, was erected by the Chester County Historical Society, August 21, 1954.

John Fritz exercised probably the greatest early influence on steelmaking in America. It may be less readily recalled that he was a member of three of our Founder Societies and president in 1894 of the AIME and in 1895 of the ASME.

SLA List of Translations

A SUPPLEMENTARY list of translations received in the Special Libraries Association Translation Pool was made available from the John Crerar Library on Sept. 1, 1954. Orders can now be placed at $1 a copy with payment in advance to: Special Libraries Association Translation Pool, John Crerar Library, 86 East Randolph Street, Chicago 1, Ill.



A scroll in appreciation of the hospitality and convention arrangements of the Brazilian Federation of Engineering Association was presented by the EJC delegation to the UPADI meetings in São Paulo. In the group, *left to right,* are Ralph A. Morgen, research director, Purdue Research Foundation; Gail A. Hathaway, past-president of ASCE; an unidentified member of the Brazilian group; President Saturnino de Brito of the Brazilian Federation; and H. L. Melvin, chief consulting engineer, Ebasco Services, Inc.

The final session of the Third UPADI Convention in São Paulo, August 6, was marked by the presentation to UPADI President Luis Giannattasio of Uruguay the certificate of Honorary Membership in ASME. Participants in the ceremony included, *left to right:* James M. Todd, chairman of the EJC delegation to the convention; an unidentified member of the Brazilian delegation; A. D. Bailey, EJC delegate to the convention; Joseph Pope, vice-chairman of the EJC delegation; Mr. Giannattasio, and A. J. Ackerman, EJC delegate.

Three Engineering Conferences in Brazil Link "Free-World" Co-Operation

UPADI, World Power Conference, and Inter-American Association of Sanitary Engineering Meet in Rio and São Paulo

MEMBERS of The American Society of Mechanical Engineers attending the Third Convention of UPADI, held in São Paulo, Brazil, Aug. 2–6, were impressed again with the mutually beneficial effectiveness of co-operative assemblies of professional men of free nations.

Pan-American Committee on Standardization

An instance was the step to reactivate the Pan-American Committee on Standardization with a view to development of an inter-American program of standards, with committee headquarters in Rio de Janeiro.

ASME participants went as delegates of Engineers Joint Council, which is constituted of eight major engineering societies of the United States with a total membership of 170,000. UPADI, or Pan-American Federation of Engineering Societies (Union Pan-Americano de Asociaciones de Ingenieros) is composed of the principal engineering organizations of most of the nations of the Western Hemisphere, with Engineers Joint Council as the United States member.

UPADI and Organization of American States

In addition to the Standardization Committee action, which was taken on a United States proposal, the convention favored maintenance of liaison between UPADI and the Organization of American States, which has an office in Washington, D. C. It was recommended that each society in UPADI strive in its country to organize a consultative technical council for a study of the nation's natural resources with a view toward national works programs. Extended discussion revolved around engineering education and the exchange of data on that subject among UPADI members. EJC has furnished UPADI with complete information on engineering education in the United States obtained from the U. S. Office of Education in Washington.

ASME members were in the EJC group that took in tours arranged for general sight-seeing and for inspection of major engineering projects. São Paulo itself, of course, was an impressive engineering achievement with its many new structures, belt roads, industrial area, commercial centers, and hydroelectric works.

Including delegates and guests, 35 attended from the United States. Registrants came from 17 Western Hemisphere countries. The next convention was scheduled for Mexico in 1956.

EJC, official participant for the United States engineering profession, furthers a program of advancement of the general welfare of the engineering profession, the co-operation of the branches of the profession, the advancement of the science and profession of engineering, and the development of sound public policies in national and international affairs wherein the profession can be helpful through the services of members of the engineering profession.

World Power Conference

The World Power Conference, held in Rio de Janeiro, July 25–Aug. 10, had 526 registrants, of whom 43 were from the United States. WPC, which has headquarters in London, England, is an association of organizations in the power field throughout the world. This meeting was regional. The next full, or world-wide, convention was scheduled for Vienna, Austria, in 1956. Typical United States papers, indicative of the nature of the discussion at Rio, were "International Water Problems and Progress Made Through Treaties, Compacts, and Agreements"; "Technical and Economic Principles Involved in Hydroelectric Developments of Common Interest to Canada and the United States"; "Development of Niagara Falls for Hydroelectric Power"; and "Engineering and Economic Problems in the Production of Electric Power From Solar Energy."

Some 100 persons, including many from the United States, attended the convention of the Inter-American Association of Sanitary Engineering, held in São Paulo, July 25–31.

IUTAM Colloquium on Photoelasticity and Photoplasticity Held in Belgium

A COLLOQUIUM on photoelasticity and photoplasticity sponsored by the International Union of Theoretical and Applied Mechanics and assisted by a UNESCO grant to the International Council of Scientific Unions was held at the University of Brussels, Brussels, Belgium, from July 29 to 31, 1954. The Organizing Committee consisted of H. Le Boiteux, France, chairman; H. Favre, Switzerland; and M. Hetényi, United States.

Twenty-seven leaders in photoelasticity and photoplasticity from Belgium, France, Germany, Great Britain, Holland, Italy, Japan, Spain, Sweden, Switzerland, and the United States presented and discussed 36 papers in the three-day period. The U. S. participants were D. C. Drucker, A. J. Durelli, M. M. Frocht, M. Hetényi, R. Mesmer, R. D. Mindlin, E. Orowan, and C. D. West.

Because of the limited funds available and the large number of photographs accompanying the papers, the Organizing Committee decided that it was feasible to encourage publication only in the usual journals, and to publish abstracts with reference to the place of publication of the complete paper where available.

Automation—A New Industrial Revolution? Theme of Davenport Conference

The Iowa-Illinois Section of The American Society of Mechanical Engineers joined with the American Material Handling Society, and the Quad-City Association of Timestudy Engineers, in co-operation with the Associated Industries of the Quad-Cities, to present a one-day conference devoted to the topic, "Automation—A New Industrial Revolution?"

Nearly 600 engineers, industrialists, and executives from all sections of the country attended the conference held at the Davenport Masonic Temple, Davenport, Iowa, on August 27.

Plant Visits

The program started with plant visits, in the morning, which included the plant of the Oscar Mayer Packing Company, processors of meat products; the ALCOA Davenport Works, where the guests saw the aluminum rolling mill for sheet and plate; J. I. Case Company's Bettendorf plant for the manufacture of farm harvesting machinery; Container Corporation of America, makers of cardboard containers; Servus Rubber Company, producers of rubber and canvas footwear; the East Moline Works of the International Harvester Company.

Technical Papers

In the afternoon the technical papers were presented by John Diebold, editor, *Automatic Controls*, whose talk included the most recent information on the present status of automation, the history of its development, and a serious look into its future; and Charles Hautau, president, Hautau Engineering Company, Detroit, Mich., who discussed automation from the viewpoint of the designer and engineer. In the evening Del S. Harder, vice president of manufacturing, Ford Motor Company, Detroit, took up the practical problems and applications of automation in production.

The events of the day included a luncheon at which time the guests heard Herbert L. Tiggs, the president of the National Machine Tool Builders' Association, discuss cogently the problems of design and manufacture of machine tools for automated manufacture.

ASME Membership as of August 31, 1954

Honorary Members	56
Fellows	393
Members	14,294
Affiliates	318
Associate Members (33 and over)	3,589
Associate Members (30-32)	3,162
Associate Members (to the age of 29)	17,388
Total	39,200

ECPD to Hold Annual Meeting in Cincinnati

The twenty-second annual meeting of Engineers' Council for Professional Development will be held at the Hotel Alms in Cincinnati, Ohio, Oct. 28-29. Cincinnati is an appropriate location for it was there that the first pilot program of "The First Five Years of Professional Development" was inaugurated in co-operation with the University of Cincinnati and a number of local industries. Cornelius Wandmacher, chairman, ECPD Training Committee, is in charge of this project. Naturally, the program will be devoted to professional development, and prominent engineers, executives, and educators will discuss the various aspects.

The pilot program in Cincinnati has been so successful that steps are being taken to initiate similar programs in other large industrial centers—Detroit, Minneapolis, St. Paul, Oklahoma City, Atlanta, Houston, St. Louis, and Hamilton, Ontario.

Several years ago the ECPD Training Committee recognized that the first five years of professional development after leaving college represented the most critical period of the young engineer's career. To meet this need the committee developed a six-point program: 1 Orientation and training in industry; 2 Continued education; 3 Integration into the community; 4 Professional registration; 5 Self-appraisal, and 6 Selected reading.

Council business and committee meetings will comprise the program of the first day. The training program will be discussed on the second day with introductory remarks on "A Community Project in Professional Development" by A. C. Monteith, Hon. Mem. ASME, vice-president in charge of engineering, Westinghouse Electric Corporation, and E. S. Fields, vice-president and general manager, Cincinnati Gas and Electric Company. Mr. Monteith was instrumental in developing the six-point program and made a detailed study in a 160-page report when chairman of the ECPD Training Committee.

A panel presentation of "Professional-Development Activities in Cincinnati" will be held, with speakers representing the points of view of industry, the engineering societies, and the university.

Frank J. Curtis, vice-president and director of the Monsanto Chemical Company, will be the luncheon speaker.

In the afternoon the community aspects of the "First Five Years' Program" in the large industrial centers of Houston, Minneapolis, St. Paul, Atlanta, Detroit, Hamilton, Ont., and Oklahoma City, will be discussed.

ECPD was organized to enhance the professional status of the engineer through the co-operative efforts of the following national organizations concerned with the professional,

Automation conferees shown, *left to right*, are: M. A. Fraher, C. W. Anderson, N. N. Sacks, Matthew Porosky, H. I. Mettee, Del S. Harder, M. H. Linn, W. C. Rosborough, R. L. Franing, and R. H. Weingartz

Automation Conference held in Davenport, Iowa, August 27, attracts audience of nearly 600 engineers, industrialists, and executives from all sections of the country. Shown in the photo is part of the audience attending the afternoon session.

technical, educational, and legislative phases of engineers' lives: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, The Engineering Institute of Canada, American Society for Engineering Education, American Institute of Chemical Engineers, National Council of State Boards of Engineering Examiners. ECPD is best known for its program of accrediting the curriculum of engineering colleges throughout the country.

The tentative program follows:

THURSDAY, OCT. 28

9:00 a.m.	Closed Council Meeting
12:30 p.m.	Luncheon
2:00 p.m.	Open Committee Meetings
3:30 p.m.	Open Council Meeting
6:00 p.m.	Dinner
8:00 p.m.	New Executive Committee and new committee organization meetings

FRIDAY, OCT. 29

9:30 a.m.

Training Committee Program

A Community Project in Professional Development: Introductory Remarks, *A. C. Monteith*, Westinghouse Electric Corp., and *E. S. Fields*, Cincinnati Gas and Electric Company

10:00 a.m.

Panel: Professional-Development Activities in Cincinnati—

For Industry: *D. F. Pratt*, Cincinnati Milling Machine Company
E. G. Huck, Cincinnati Gas and Electric Company

For Engineering Societies: *S. F. Storer*, Engineering Society of Cincinnati
Raphael Katsen, consulting chemical engineer

For University: *Hoke Greene*, dean of Graduate School, University of Cincinnati
William Middendorf, chairman, Professional Guidance Committee, University of Cincinnati

12:00 Noon

Luncheon

Speaker: *Frank J. Curtis*, vice-president and director, Monsanto Chemical Company

2:30 p.m.

Community Aspects of the "First Five Years" Program" in
Houston—*Mr. McKelta*
Minneapolis-St. Paul—*Mr. Hill*
Atlanta—*Messrs. Sweigert, Higgs, and O'Brien*
Detroit—*Mr. Freund*
Hamilton, Ont.—*Mr. Schneider*
Oklahoma City—*Messrs. Danner and McKeithan*

7:00 p.m.

Dinner

Speaker: *James H. Taylor*, Assistant Director for Manpower, Office of Defense Mobilization
Subject: **The National Manpower Outlook From the Point of View of the Profession**

ASME Metropolitan Section Arranges Plastics-Engineering Symposium

A PLASTICS-ENGINEERING symposium of eight sessions has been arranged by the ASME Metropolitan Section Machine Design Division in co-operation with the Society of Plastics Engineers. J. H. DuBois will serve as general chairman.

The symposium, which was begun Monday, September 20, will continue on Monday evenings through November 15, until all of the eight sessions have been presented.

The symposium will present an outstanding plastics specialist in each phase of the industry, covering the philosophy, materials, methods, limitations, equipment, and services of the plastics industry. Illustrations will be by motion picture, sample displays, slides, and direct demonstration.

Two papers were given at the first session of the symposium. "Plastics Industry," by Hiram McCann, editor of *Modern Plastics*, took up the components of the industry, the statistics, and the interrelationship that exists between the various components. Henry M. Richardson, treasurer, DeBell & Richardson, Hazardville, Conn., in his paper on organic plastics, told of the chemical structure of the synthetic resins. In the second session Prof. A. J. Monack, Newark College of Engineering, discussed the inorganic plastics and ceramics. Ceramic products were included in the series because of the fast-growing requirements for high-temperature insulation. M. Wismer of Ciba, Inc., covered the subject of the cast plastics, those resins which may be poured into simple molds and subsequently hardened by a chemical reaction. Dr. Wismer noted the accelerated use of cast resins for tools, jigs, dies, and models, with relatively unskilled labor and with simple shop equipment. The session ended with a paper by Leon R. Egg, vice-president and chief engineer, Garfield Manufacturing Company, Garfield, N. J., in which he told of the first plastics to be used—cold-mold plastics.

Starting in October, sessions 3, 4, and 5 will be given on Oct. 4, 11, and 18. The papers scheduled for presentation cover the following topics: Natural and synthetic products, silicone rubber, elastomers and nonrigid plastics; cast plastics and fabricated parts; thermosetting plastics and thermoplastic products. The November 1 session, number 6 in the series, will cover reinforced plastics and extrusion plastics and blownware. Sessions 7 and 8 will be held on Nov. 8 and 15.

1955 Mechanical Catalog Available

THE 1955 MECHANICAL CATALOG, recently published, is now being distributed to ASME members upon request. The current edition of the catalog contains 50,000 listings of more than 6000 products of 3500 manufacturers and 348 pages of charts, photographs, and detailed drawings to aid engineers in their specifying and buying functions.

Constant editorial scrutiny of listings, industry-inspired phraseology revisions, and a continuous flow of suggestions from ASME members, serve to make the volume invaluable to engineers in 21 basic industries.

Another important feature of the volume is the 20-page descriptive listing of all ASME publications. It permits users to check their requirements for special ASME publications and for the latest standards and codes.

Twelve Regional Student-Branch Conferences Conclude Successful 1953-1954 Season

FOURTEEN-HUNDRED student members of The American Society of Mechanical Engineers, representing most of the 136 student branches of the Society, were present at the 12 regional student conferences held during March, April, and May of this year. Students from more than 110 colleges and universities participated.

The conferences provided an opportunity for student chairmen to report on activities of the branches during the year and to discuss informally the problems facing their respective branches. Many reported an active and successful season with, however, the ever-present problem of securing adequate attendance at branch meetings. In some cases extensive help from local sections was reported, including financial support, aid in developing industrial contacts, providing prizes for papers, and providing speakers for meetings. Counselors appointed by local sections to handle student-branch problems came up for much discussion. It was noted that these counselors were particularly valuable when branches were not near a local section.

Another well-discussed topic was the present scoring system applied to papers entered in competition, especially in connection with points allotted for originality. It was felt that these points should be reduced since many students did not have a chance to do original research until their senior year. In a discussion of prizes awarded at student conferences, it was suggested that some form of prize other than money be considered. Increasing student transfers to Associate Member, Student-Branch finances, and how to provide for better continuity of branches from year to year were other topics taken up at the conferences.

Student Papers High in Quality

The diversified interests of the students were reflected in the wide variety of subjects they chose for their papers. Many of the papers were above average in content and presentation. Because of the general high quality of the papers, judges had difficulty in deciding winners in some cases. The importance of these meetings was stressed at the conferences because they help to develop the students' initiative and ability to speak in public and give them a sense of responsibility toward their profession. Host colleges deserve much credit for their hard work in arranging the excellent programs and their contributions to the general success of the conferences—social and professionwise. Besides the well-run technical programs, students heard stimulating talks by local and national ASME officials, local industrial and civic leaders at the banquets and luncheons scheduled. A variety of field trips to engineering

laboratories and local industries were also arranged.

High Lights of Conferences

An address on "Learning and Life," by L. K. Sillcox, ASME President, was one of the features of the Region I conference held at Clarkson College of Technology. Also on the program was an inspection tour to the Massena Works of the Aluminum Company of America. Eight papers were presented at this conference.

Students from fourteen colleges participated in the Region III student conference at the University of Rochester. In addition to prizes for papers, a man-mile plaque was awarded to the University of Delaware. The 1955 conference is scheduled to be held at Johns Hopkins University in conjunction with the ASME Diamond Jubilee Spring Meeting.

The Region IV Student Conference was held at the University of Tennessee in conjunction with the Regional Administrative Committee meeting. On the program was a banquet at the Andrew Johnson Hotel in Knoxville, at which students heard an address by Paul R. Yopp, vice-president of Region IV. Field trips were made to the American Museum of Atomic Energy at Oak Ridge and to the Kingston Steam Plant of TVA. The man-mile trophy was won by the University of Florida.

More than 270 students and guests were present at the successful Region V conference at Wayne University. Atomic energy was featured at the banquet with talks on "Some Peacetime Applications of Nuclear Energy" and "Generating Electric Power From Nuclear Energy." A film "A—Is for Atom" was shown at the banquet. Students were guests of General Motors Corporation during a trip through the General Motors Technical Center. The University of Dayton won the award for the most man-miles traveled. The next conference will be at the University of Toronto.

Region VI Holds Two Meetings

Host for the Region VI Northern Tier conference was the University of North Dakota. The address at the banquet was delivered by Daniel Q. Posin, chairman, physics department, North Dakota Agricultural College, on the topic "The Atomic Problem Today—Power and Fury." The winning paper also discussed atomic energy. It was titled "Nuclear Power and You" and was presented by L. F. Sander. Ten papers were presented at this conference.

An Engineers' Ball at the Henry Clay Hotel was one of the high lights of the Region VI Southern Tier conference held in Louisville, Ky. Host college was the University of Louisville. Plant tours, a luncheon, and a banquet at which N. C. McPherson, Jr., spoke, were also on the program. The trophy for the most man-miles traveled went to Bradley University, which will be host for the 1955 conference.

The campus of the University of Arizona was the setting for the Region VII Pacific Southwest conference. The program featured campus tours and a field trip to the Arizona Desert Museum. At the convention banquet students were addressed by Walter T. Lucking of the Arizona Public Service Company, on "Our Place in a Changing World." Next year's conference will be held at the University of California at Berkeley.

Many interesting field trips were a feature of the Region VII Pacific Northwest Student Conference at the University of British Columbia, Vancouver, Can. These included trips to Vancouver International Airport, Sumner Iron Works, Canadian Pacific Air Lines workshop, Universal Lumber and Box, Fraser Mills, and the clay-products plants of Clayburn Company, Ltd. Guest speaker at the banquet was H. F. Foley, president of the Powell River Company, who spoke on "The Value of an Engineering Education." Winner of the man-mile trophy and the attendance trophy was Oregon State College. This college will be the conference site for 1955.

Region VIII Holds Three Conferences

A high point of the Region VIII Northern Tier student conference was the banquet address by C. V. Elwell, The Western Company, Midland, Texas, on the subject, "Engineers Versus Human Beings." Students were also addressed by President L. K. Sillcox. This meeting was held in connection with the Annual Region VIII Conference, Tulsa, Okla. The Mid-Continent Section played host to the students. Next year's meeting will be held at Oklahoma University.

Twelve papers were on the program of the Region VIII Southern Tier conference at Louisiana Polytechnic Institute. The winning paper was "Single-Cylinder Free-Piston Engines," by Ernest Funk of the University of Texas. Winner of the man-mile trophy and the "largest percentage of student members attending" prize went to Tulane University. Field trips to the Hodge Paper Mill and some salt mines, and a Louisiana shrimp boil were part of the program. Host for the next conference is Rice Institute. It will be held concurrently with the regional meeting.

The Region VIII Rocky Mountain Tier conference was held at the University of Colorado. The banquet speaker at this conference was Russell B. Scott, chief, Cryogenic Engineering Laboratory, National Bureau of Standards, Boulder, Colo. He spoke on "Cryogenic Engineering." The 1955 conference will be held at the University of New Mexico.

1954 ASME Regional Student Conference Prize Winners

REGION I, NEW ENGLAND, CLARKSON COLLEGE OF TECHNOLOGY, POTSDAM, N. Y., MAY 7–8, 1954

Attendance: 196 — Papers Presented: 8

Prize	*Recipient*	*Title of Paper*	*College*
First	Edward A. Kaszynski	Explanation of Chip Curl and a New Look at Material Flow in Metal	Massachusetts Institute of Technology
Second	Robert W. Traver	The Sendzimir Mill for Cold-Rolling Metal Strips	Clarkson College of Technology
Third	Robert C. Stempel	Improved Braking System for an Automobile	Worcester Polytechnic Institute
Fourth	Allen Brickett	Shallow-Water Diving Apparatus	Tufts College
Old Guard	Russell Holman	Instrumentation and Operation of an Experimental Gas Turbine	University of Vermont

REGION II, EASTERN, POLYTECHNIC INSTITUTE OF BROOKLYN, BROOKLYN, N. Y., APRIL 14, 1954

Attendance: 125 — Papers Presented: 5

Prize	*Recipient*	*Title of Paper*	*College*
First	Raymond W. Lloyd, Jr.	The Use of Silicone Compound as a Damper in Yarn Compensating Devices	Newark College of Engineering
Second	Daniel Rosner	Rockets and Escape From the Earth	College of the City of New York
Third	Emil Rogner	The "C" Process—A New Casting Process	Polytechnic Institute of Brooklyn—Day
Fourth	Gideon Kanner	Atomic-Energy Reactors	Cooper Union School of Engineering
Old Guard	Albert Goldstein	Electric Analog for Mechanical Systems	Pratt Institute

REGION III, ALLEGHENIES, UNIVERSITY OF ROCHESTER, ROCHESTER, N. Y., APRIL 30–MAY 1, 1954

Attendance: 75 — Papers Presented: 14

Prize	*Recipient*	*Title of Paper*	*College*
First	Ronald E. Philipp	The Telexpander—An Original Solution to an Industrial Problem	Lafayette College
Second	Francis E. Campagna	Hydraulic Analog to the Design and Performance Characteristics of Perforated Supersonic Diffusers	Lehigh University
Third	Daniel M. Isaacson	Design Problem and Automatic Folding of Nonrigid Material	Cornell University
Fourth	Peter J. Hasslacher	Automotive Steam-Power Progress	Princeton University

REGION IV, SOUTHERN, UNIVERSITY OF TENNESSEE, KNOXVILLE, TENN., MARCH 26–27, 1954

Attendance: 151 Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	Joe Hucks	A Comparison of Conventional Spark and Compression Ignition With the TCP Engine	University of Florida
Second	William T. Snyder	Journal-Bearing Operation With a Submerged Oil Supply	University of Tennessee
Third	Charles Taylor	Law and Ethics for Engineers	University of South Carolina
Fourth	Richard K. Keith	An Experimental Investigation of Firing Stresses in an 8-Mm Mauser Rifle	North Carolina State College
Old Guard	Bluford L. Moor, Jr.	The Free-Piston Engine	Mississippi State College

REGION V, MIDWEST, WAYNE UNIVERSITY, DETROIT, MICH., APRIL 26–27, 1954

Attendance: 272 Papers Presented: 9

Prize	*Recipient*	*Title of Paper*	*College*
First	Richard Brown	Mass-Precision Roller Gaging	University of Akron
Second	James E. Bigler	Cool Flames	Ohio State University
Third	Benjamin E. Bader	Powder Metallurgy	Ohio University
Fourth	George J. Roth	Capacitance-Welding Technique for the Installation of Thermocouples	University of Dayton
Old Guard	Richard D. Walker	Oil Pipe Lines	University of Toronto

REGION VI, NORTHERN TIER, UNIVERSITY OF NORTH DAKOTA, GRAND FORKS, N. DAK., APRIL 26–27, 1954

Attendance: 82 Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Louis F. Sander	Nuclear Power and You	Marquette University
Second	William E. Miller	Motor-Vehicle Behavior Under Various Braking Conditions	University of Wisconsin
Third	Dwight Baumann	As Easy as Pi	North Dakota Agricultural College
Fourth	Roger Gay	Crosley to Custom	Illinois Institute of Technology
Old Guard	Ray Kobe	5W-20 Lubricating Oils	University of North Dakota

REGION VI, SOUTHERN TIER, UNIVERSITY OF LOUISVILLE, LOUISVILLE, KY., APRIL 8–9, 1954

Attendance: 122 Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Clyde F. Young	Capillary Tubes for Refrigeration Units	University of Illinois
Second	Edwin Stear	Laboratory Apparatus for Nozzle-Flow Study	Bradley University
Third	Samuel Robinson	Compressed-Air Equipment in Production	University of Louisville
Fourth	Richard Gundlach	Industrial Application of Free-Piston Gasifier	Washington University
Old Guard	Donald B. Young	A Problem in Incentive Administration in the Meat-Packing Industry	University of Iowa

REGION VII, PACIFIC NORTHWEST, UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER, B. C., CAN., APRIL 29–MAY 1, 1954

Attendance: 91 Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Alfred W. Harris	Increasing the Volumetric Efficiency of Model Aeroplane Engines	University of Washington
Second	John Telgener	Operation of a New Semihardboard Plant	University of Idaho
Third	Gordon Woodcock	Flight Research Radio-Control System	Oregon State College
Fourth	Bryce Johnson	The Johnson Potato Harvester	University of Idaho
Old Guard	Robert Loundagin	Rocket Engines	State College of Washington

REGION VII, PACIFIC SOUTHWEST, UNIVERSITY OF ARIZONA, TUCSON, ARIZ., APRIL 30–MAY 1, 1954

Attendance: 150 Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	Daniel A. Tepple	Supersonic-Flow Studies by Hydraulic Analogy	University of California, Berkeley
Second	Larney J. Hearty	Inerting Explosive and Flammable Atmospheres in Open Containers With Carbon Dioxide or Nitrogen Gas	University of Utah
Third	George M. Takis	An Electric Analog for Periodic Heat-Transfer Problems	Stanford University
Fourth	Leon Lee Kielman	The Evaluation of Quenching Oils by Means of a Special Thermocouple	University of Arizona
Old Guard	William C. Reynolds	Design and Model Tests of an Exhaust-Stack Ventilation Ejector	Stanford University

REGION VIII, NORTHERN TIER (MID-CONTINENT SECTION, HOST) TULSA, OKLA., APRIL 25–27, 1954

Attendance: 63 Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	Edward Burkholder	LPG-Carburetor Systems	Oklahoma A&M
Second	Everett T. Hart	Foot Temperature and Human Comfort	Kansas State College
Third	Kenneth May	An Instantaneous and Over-All Mileage Meter	University of Kansas
Fourth	Daren L. Lucke	Automatic Car Parker	University of Arkansas
Old Guard	Duan P. Whelan	Recent Developments of the Hot-Air Engine	University of Oklahoma

REGION VIII, ROCKY MOUNTAIN TIER, UNIVERSITY OF COLORADO, BOULDER, COLO., APRIL 2–3, 1954

Attendance: 81 Papers Presented: 16

Prize	*Recipient*	*Title of Paper*	*College*
First	Richard L. Gray	Automotive Air Conditioning	Texas Technological College
Second	Clifford A. Hauenstein	The Mechanical-Engineering Curriculum in the Eyes of the Student	University of Denver
Third	Kenneth E. Taylor	Vibrations of Piping Systems	Texas Technological College
Fourth	Samuel L. McClaren	Hydrofrac; Past, Present, and Future	Colorado School of Mines
Old Guard	Bill Craig	Gas-Turbine Problems in the Automotive Field	New Mexico College of A&M Arts

REGION VIII, SOUTHERN TIER, LOUISIANA POLYTECHNIC INSTITUTE, RUSTON LA., MARCH 28–30, 1954

Attendance: 65 Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	Ernest Funk	Single-Cylinder Free-Piston Engines	University of Texas
Second	Richard H. Garrett	The Garrett 'Prest-Air' Cooker	Rice Institute
Third	Charles Fagg	Problems of Cost	University of Texas
Fourth	Robert L. Davis	Airborn Radar as a Mechanical-Engineering Problem	A&M College of Texas
Old Guard	Bernard J. Bagley	Are Oil Filters Effective?	Southern Methodist University

Prizes, Other Than for Papers, Presented at Student Conferences

1 Two prizes of $25 and $15 were awarded at each Conference to the Student Branches, other than the host college, having the largest and next largest percentage of Student Members attending.

2 A Certificate was presented at each Conference to the Student Branch having the largest percentage of potential Student Membership in the third through sixth years among Student Branches participating.

3 Each Conference presented a Man-Mile Trophy for the Student Branch that traveled the greatest number of man-miles to the Conference. The winners are listed in the following table:

Region	*$25 Prize*	*$15 Prize*	*Potential Student-Membership Certificate*	*Man-Mile Trophy*
I			University of New Hampshire and Thayer School	
II	Cooper Union School of Engineering	College of the City of New York	Newark College of Engineering	Newark College of Engineering
III	University of Delaware	U. S. Naval Academy Midshipman School	Swarthmore College	University of Delaware
IV	North Carolina State College	University of South Carolina	University of South Carolina	University of Florida
V	University of Dayton	University of Akron	University of Dayton	University of Dayton
VI	South Dakota State College	North Dakota Agricultural College	University of North Dakota	Michigan College of Mining and Technology
Northern Tier				
VI	Rose Polytechnic Institute	Bradley University	Rose Polytechnic Institute	Bradley University
Southern Tier				
VII	Oregon State College	State College of Washington	University of British Columbia	Oregon State College
Pacific Northwest				
VII	University of Utah	University of Santa Clara	University of Nevada	University of Utah
Pacific Southwest				
VIII	University of Arkansas	Kansas State College	University of Oklahoma	Kansas State College
Northern Tier				
VIII	University of Denver	Colorado A&M College	University of Denver	Texas Technological College
VIII	Tulane University of Louisiana	Louisiana State University	Louisiana Polytechnic Institute	Tulane University of Louisiana
Pacific Southwest				

Junior Forum

Conducted by Joseph Schmerler, Assoc. Mem. ASME

What's in a Name?

When the membership-grade designation of "Junior Member" was replaced with "Associate Member" this year, the National Junior Committee had to decide whether or not to change its title accordingly. The Committee is currently of the opinion that the name should remain as before despite the fact that there will be an obvious inconsistency.

The reason for this decision is simply that no new name has been suggested to date that adequately connotes the position and nature of the Committee. Some suggestions that were given consideration are: National Associate Committee, Associate Committee of ASME, National Associate Member Committee, and National Committee for Associate Members. These, and others of slight variation, were rejected because in each instance the title either did not convey the meaning of the Committee as to its function or national character, were too vague in the meaning of "Associate," or were too long and thereby lost their value.

The Committee realizes that some of the Junior Groups or Committees that function within various sections of the Society have changed their designation while others have not. Accordingly, the action of the Committee leaves the matter open for further consideration but final to the extent that the name will stay the same until a better one is submitted and accepted.

National Junior Committee Report

The National Junior Committee, in order to render an accurate Annual Report on its progress to Council, is endeavoring to evaluate activities undertaken not only during the past year but the whole program of the past few years as well. For this purpose a subcommittee was appointed to read over the Committee minutes of the past four years and also to compare the aims and activities of the Committee as it stands today with the original purpose of the Committee when it was organized six years ago. It is expected that some shift in emphasis has taken place in the past few years if only because we are no longer in a postwar readjustment period.

Corresponding Member Program

In order to insure adequate communication with Associates throughout the country, the National Junior Committee adopted a Corresponding Member Program a little over a year ago. To survey the effectiveness of this activity, a postal-card questionnaire was mailed to each Corresponding Member asking him whether or not he wished to be continued in the program and if he did wish to be continued on the list, whether he would accept appointment as a Junior Adviser to any of five listed Society committees.

The response from 102 mailed questionnaires was 52 returns, with 16 desiring to be dropped from the program. Of the 36 asking to be continued as Corresponding Members, 23 were willing to accept appointments as Junior Advisers while 13 indicated that lack of time or geographical location would not permit such activity.

A breakdown of the list was made according to desired activity and has already proved a useful tool in selecting two replacements for Junior Advisers to Society Committees and two Associates to serve on the Junior Forum subcommittee.

Membership in the Corresponding Member program is by no means exclusive. Where sufficient interest is aroused in any Associate to stir him to communicate with this column, in care of Mechanical Engineering, participation is assured.

In keeping with the Committee activity of analyzing its performance during the past few years in order to prepare future programs, the Committee has asked that the Society use the 1954 Membership Survey Questionnaire to obtain a correlation of certain questions asked to the number of years that have elapsed since graduation. This information will aid the Committee in the respect that the major functions of Associates in their occupation will become known and National Junior Committee attention can be directed in programming to the neglected areas. Also, an attempt to improve attendance at meetings will be made once it is learned what factors within and without the Society prompt Associates to attend or to absent themselves from meetings.

Chicago Report

By T. H. Gluck, Chairman, Associate Group, Chicago

This past year, under the guidance of Robert Mindak, the Associate Group of the Chicago Section furnished six after-dinner speakers for regular Section meetings, conducted the Third Annual Prize-Papers Contest, and had Associate representatives on various Section committees.

A large number of younger engineers have been integrated into the operating group of the Chicago Section, enabling these men to learn the operations of the Section while they are Associates. Another action taken by the Section was to change the name of the Junior Group to Associate Group in line with the change in the name of this membership grade. The Associate Group, which is comprised of 13, has, under its new chairman, T. H. Gluck, scheduled a program for the coming year which includes the appointing of two committees to aid the Senior Membership Committee in getting Student Members to transfer to Associate Members upon graduation, preparation of the Annual Smoker and the Prize-Papers meeting, and again furnishing six after-dinner speakers for various Section meetings. The Civic Responsibility Committee will have a representative from the Group as will the Power Conference Committee.

For the 1955 Diamond Jubilee a Diamond Jubilee Associate Committee has been appointed with R. Mindak and R. Holstpet as co-chairmen.

ASME Woman's Auxiliary Reports on Scholarships

The Woman's Auxiliary to The American Society of Mechanical Engineers recently reported on the Calvin W. Rice Memorial Scholarship Fund and the Sylvia W. Farny Scholarship.

The reports were submitted by the chairmen of both committees: Mrs. Allan R. Cullimore for the Calvin W. Rice Memorial Scholarship and Mrs. Ralph L. Goetzenberger for the Sylvia W. Farny Scholarship.

A. R. Durrani Receives Rice Scholarship

The Calvin W. Rice Memorial Scholarship for 1954-1955 has been awarded to Abdul Rauf Durrani of Pakistan. He is 26 years old, unmarried, and has a BS(ME) degree from the University of Karachi, standing first in his class. He is an examiner in the mechanical and electrical departments at the Government College at Sind.

Mr. Durrani is at present employed by the Government of Pakistan, Ministry of Industries, as assistant director of supply and purchasing agent of special equipment. He has excellent recommendations from his superiors in the government employ and from his professors at the University. He wants to study earth-moving, road-making, and agricultural equipment, diesels, and diesel electrics. He has been recommended for a travel grant under the U. S. Fullbright Program. He will study at Purdue University during the present academic year.

Sylvia W. Farny Scholarship

The Sylvia W. Farny Scholarship of $500 is awarded annually by the Woman's Auxiliary to The American Society of Mechanical Engineers. The scholarship is open to American men and women undergraduate students in mechanical engineering who are enrolled in an accredited curriculum in a college or university in the United States in which there is an ASME Student Branch. It is for use during the student's final undergraduate year. The award is granted on the basis of financial need, scholastic achievement, and character.

Because of the large number of engineering schools throughout the country, it was necessary to divide the schools into groups. The scholarship rotates annually among these groups. During the fall of each year the participating colleges are notified, and application forms are made available.

Faust S. D'Avello, formerly a student at the

University of Akron, was the recipient of the first Sylvia W. Farny Scholarship, which was granted in 1953.

This year, as the result of an expanding organization and through the generous contributions of its Sections, the Auxiliary granted two $500-scholarships. The recipients are John W. Smylie, Mississippi State College, and Arthur S. Rathbun, Rensselaer Polytechnic Institute.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members, or nonmembers and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Engineer, young, ten years' experience, project, precision products, special machinery. Development, design, manufacturing follow-up. Mechanical, pneumatic, hydraulic. Seeks responsible position peacetime industry. Prefers New York metropolitan area. Me-119.

Technical Writer, mechanical engineer; 34; experienced writer, editor, designer, and extensive flight experience as Air Force officer. Desires technical writing or editing work in aircraft or missile navigation and control. Me-120.

Administrative Engineer, mechanical-engineering graduate; 42; wide experience in mass-producing metalworking industries, including design, sales, production, construction, and maintenance. Desires position in, or leading to, California area. Me-121.

Mechanical Engineer; 23, single; BME; two years' design and development on jet-aircraft hydraulic systems and equipment. Desires engineering position in aircraft industry where experience can be used to best advantage. Me-122.

Mechanical Engineer; 40; 15 years' experience in plant engineering and machine design; 1½ years' maintenance administration; desires position in plant-engineering field with a potential for position in plant management. Me-123.

Mechanical Engineer, BSME, registered. Power-plant testing, operation, water treatment, and heating, ventilating, and air-conditioning design experience. Desires responsible power-plant engineering or air-conditioning design position. Me-124.

Mechanical Engineer, registered; 55; 35 years' diversified experience—apprentice, machinist, foreman, plant engineer, construction superintendent, plant manager. Desires responsible position. Location immaterial. Me-125.

Director of Development, Research, or Chief Engineer; PhD Mechanical; 42; mechanical, structural, plastics, or allied field; 20 years of diversified experience in transportation and aircraft. Excellent record and references. Prefers small or medium-sized organization. Will deal with top executive only. Me-126-969-Chicago.

Plant Manager, BSME, MBA; 34, married; 11 years' all phases metal manufacturing; machinist, foreman, production manager, staff assistant, top management; now responsible for 500-employee factory. Desires similar position. Me-127-Detroit.

Mechanical Engineer; 31; six years' varied experience in production, methods, hydraulic, and electromechanical design. Desires position in production or methods engineering. Prefers New York metropolitan area. Me-128.

[1] All men listed hold some form of ASME membership.

Plant Engineer, BSME, MBA; registered professional engineer in Ill., Ohio; 29; seven years' diversified plant-engineering experience. Strong background in cost control. Desires position requiring management abilities. Prefers Middle Atlantic or New England. Me-129-970-Chicago.

Mechanical-Industrial Engineer, BSME, BA Chemistry; 32; seeks challenging position in cost reduction, waste control, plant engineering and layout, materials handling, methods studies, statistics, design, and technical writing. Will travel. Me-130.

Chief Engineer, mechanical graduate; 17 years of supervision; tool and machine design; methods; cost estimating. Currently chief engineer contract-manufacturing concern making small, mass-produced parts for automotive, electrical, and novelty industries. Me-131.

Mechanical Engineer, integrated background in product design, development, research, technical management. Light to heavy industrial equipment, ordnance, plant engineering. Particular interest in building personnel. Advanced degree. Registered. Desires lead, or assistant, position in small firm or equivalent. Me-132.

Positions Available

Chief Engineer, 40–45, mechanical-engineering degree, to take charge of entire engineering program; will be directly responsible for research and development, for a manufacturer of machine tools. Will act in an advisory and consulting capacity to all branches of engineering. $20,000–$25,000, plus bonus. New England. W-159.

Plant Engineer to take complete charge of maintenance and tooling of large electromechanical equipment. Must have considerable background in tool and die work. $8000–$10,000. N. J. W-193.

Technical Research Director, 38–50, preferably PhD; must have at least ten years' experience in vinyl and thermoplastics, including extrusion. Should also have good management experience. $15,000. New York, N. Y. W-195.

Production Manager, at least ten years' light-metal manufacturing and plating experience covering electromechanical components and radio hardware. $10,000–$12,000. N. H. W-226.

Chief Engineer, under 50, at least ten years' executive, administrative, and product-application experience in mechanical, electrical, chemical, and metallurgical fields, covering automotive and aircraft accessories. To $25,000. Ohio. W-281.

Wind-Tunnel Test Engineers, aeronautical or mechanical, for aeronautical research and development work on the staff of a 7.75 × 11 ft subsonic wind tunnel. Should have minimum of two years' experience in aerodynamic design, development, or research. Opportunity for graduate work in aeronautical engineering. $5000–$5575. East. W-303.

Chief Industrial Engineer, who has had broad experience and exceptional ability in various fields of industry, to direct a program of industrial development in an ancient country rich in natural resources. Will supervise and direct necessary investigation of raw-process materials; evaluate cost and adequacy of fuel, water, power, and transportation required, and ability of local markets to profitably absorb manufactured products; supervise and direct economic study and justification, design specifications, bid proposals and evaluation, contract negotiations, etc.; construction and operation of industrial plants and facilities. Duration, minimum of one year. Salary, related to past earnings, ranges from $14,440 to $18,000, plus cost of living allowance. Transportation provided. Far East. F-325.

Supervisor of Industrial Engineering, 35–45, mechanical or industrial-engineering graduate, with time-study, methods, and considerable wage-incentive experience in metal products and coil-winding fields, to supervise time study, methods tooling, costs, and incentives for electrical-equipment manufacturer. $6000–$8000. Conn. W-341.

Die Designer, capable of training and supervising foreign engineers in tool and die design for the types of equipment listed: typical railroad forge-shop equipment; various sizes of national hot-heading and forging machines; various sizes of national open and solid die cold headers; nut-blanking machines; swaging machine, and 500-ton hydraulic press. Will do actual design work as well as training and supervising. Must have had heavy practical experience. Base salary, plus living allowance; air transportation is provided to and from the job. Two-year contract. Near East. F-349.

Staff Industrial Engineer, 32–38, engineering graduate, at least five years' experience in industrial engineering covering work measurement, methods study, wage incentives, plant and equipment layouts, process analysis, and cost-control systems. Approximately $10,000. Considerable traveling. Headquarters, New York metropolitan area. W-365.

Administrative Engineer, under 30, mechanical-engineering graduate, three to five years' machinery design, manufacturing, and office experience, to analyze and prepare reports covering engineering costs, product improvement, job analysis, schedules, etc. $7500. New York, N. Y. W-380.

Administrator of Mechanical Design, 35–45, engineering degree, at least ten years' experience in responsible charge of design and development engineering in the precision-machinery or electromechanical fields. Must understand design for production and have a background of experience covering quality and reliability of products. $10,000–$12,000. N. J. W-386.

Chief Plant-Industrial Engineer, 35–45, industrial or mechanical graduate, ten years' experience covering the application of labor standards for standard-cost and supervisory-control purposes. Will take charge of operating supervision, union representatives, and staff personnel at policy-making level on all matters pertaining to labor standards and their application. Apply by letter stating salary requirements. W-387.

Engineers. (*a*) Vice-president, 40–45, at least 12 years' engineering operating and managerial experience in water-works fields. $12,000–$14,000. (*b*) Manager, 35–45, at least ten years' experience covering operation, maintenance, and construction of water-works systems. $5000–$7500. East. W-388.

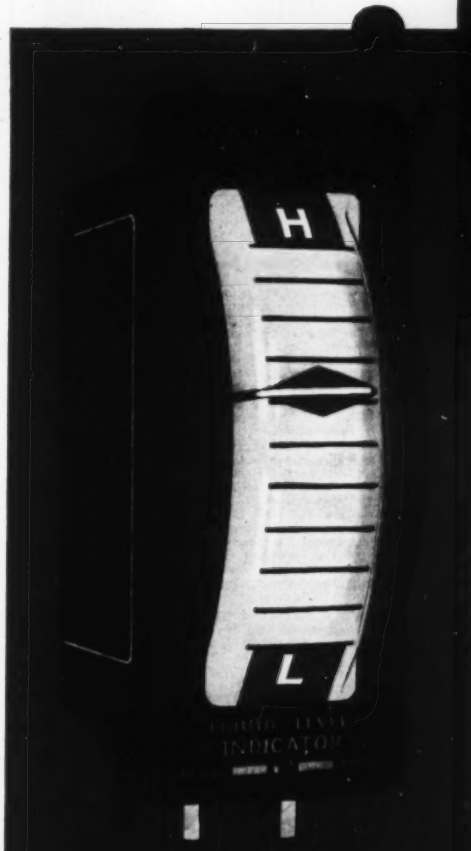
Chief Engineer, 40–50, mechanical-engineering graduate, at least ten years' design project, and executive-engineering experience on high-speed 4-cycle diesel engines. $15,000–$20,000. East. W-411.

Plant Engineer, plant-engineering and production experience in metal-products manufacturing fields, to supervise tooling, production layout, polishing, spraying, and general-equipment maintenance including air conditioning, heating, etc. $10,000, plus bonus. N. J. W-425.

Production Engineer who has had at least five years' experience in the manufacture of insulated wire and cable, preferably with experience in plastic insulations. Manufacturing experience is required in preference to design experience. Conn. W-438.

Engine Designer, to 55, at least three years' experience in designing or developing heavy internal-combustion engines. Duties will involve project-work designing and developing heavy internal-combustion engines. Some field work and contact with customers. Will understudy chief engineer. $7000. Employer may negotiate fee. Iowa. C-2145.

(*ASME News continued on page 872*)



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He is a Yarway craftsman, assembling Yarway Remote Liquid Level Indicators . . . and the care he is taking is one of the reasons why Yarway Remote Indicators are just about the safest boiler insurance you can buy.

Every part is precision-machined. Every assembled instrument is precision-tested. In the Yarway Research Laboratory a stock indicator passed the equivalent of 100 years normal use with no parts replacements, no serious wear. In thousands of power plants, ashore and afloat, Yarway Indicators are giving similar dependable service.

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Sales Manager, Tanks; to 43, at least two years' experience in the sale of steel tanks, pressure vessels. Knowledge of markets and sales management. Duties will involve supervision of national sales of steel tanks, pressure vessels, etc. $10,000–$15,000. Employer will negotiate fee. Some traveling. Headquarters, Chicago, Ill. C-2164.

Project Engineer, mechanical or electrical graduate, to 30, at least two years' experience as project assistant in consulting office on power plants or utilities and preferably in instrumentation. Knowledge of boilers and accessories. Duties will involve co-ordination of engineering and ultimately field-sales assistance in public-utility field on controls and instrumentation of boilers. May lead ultimately to sales. $6000–$8000. Employer will negotiate fee. Ind. C-2167(*a*).

Machine-Designer, mechanical, 28–35, at least five years' experience in light automatic machine design. Knowledge of electric-machine wiring and control circuits, project work on special machine design. $6000–$6500. Employer will negotiate fee. Chicago, Ill. C-2174.

Designer, cranes and shovels, mechanical graduate, 40–50, at least five years' experience in designing construction machinery. Knowledge of complete unit and speeds. Duties will involve designing construction equipment and later supervising other engineers. Company manufactures construction equipment. To $12,000, depending upon experience. Employer will negotiate fee. Chicago, Ill. C-2196.

Process Engineer, strong experience in tooling for small press operations. Product involves small parts pressed from light-gage steel, brass, or copper. Duties will be heavy in tool engineering and lighter in general processing. $7200. Detroit area. D-9546.

Engineers: (*a*) Mechanical engineer, 40–45, about 18 years' experience in design, engineering, and construction of steam-power plant facilities. As member of plant-engineering staff of large manufacturer, will be responsible for recommendations and decisions involving design of installations, specifications control, and approval of detail proposals. (*b*) Same as afore-mentioned in field of heating, ventilating, and air conditioning. $7500–$9500. Midwest. D-9549.

Mechanical-Process Engineer, good background in electric-motor applications on diversified machinery, switches, timers, hydraulic circuits, etc.; employed in high-production industry. Will design and devise improvements and changes as part of plant-engineering section. Salary open. Detroit, Mich. D-9550.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Oct. 25, 1954, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

Key to Abbreviation

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

New Applications

For Member, Associate Member, or Affiliate

ANCELLOTTI, JOHN A. J., Somerville, N. J.
ANDERSON, ANDREW M., Schenectady, N. Y.
AYDELOTT, MAX M., S. Pasadena, Calif.
BALL, ROBERT W., Godfrey, Ill.
BARNES, THOMAS C., Pensacola, Fla.
BASSOFF, LEONARD, Fanwood, N. J.
BEALL, THORNTON, New York, N. Y.
BELL, VINCENT G., JR., Ambler, Pa.
BENGTSON, JOHN M., Charleston, W. Va.
BERMAN, KURT, Schenectady, N. Y.
BIRD, JOSEPH L., Hingham, Mass.
BLISS, AMES, Houston, Texas
BOREHAM, HOWARD B., Burbank, Calif.
BRADLEY, GEORGE A., Adrian, Mich.
BRAND, WARREN H., Blue Bell, Pa.
CANHAM, GEORGE E., West Orange, N. J.
CARLETON, JOHN J., Honolulu, T. H.
CHATFIELD, CHARLES F., Scarsdale, N. Y.
COLE, THEODORE R., Los Alamos, N. Mex.
COOGAN, GERALD J., Paterson, N. J.
COOK, JAMES C., JR., Clemson, S. C.
COTTRELL, JOSEPH L., Tulsa, Okla.
CROMBIE, ALLEN P., Portland, Ore.
CROSS, C. SPENCER, Ocean City, N. J.
DE TORRONTEGUI, LEANDRO J., Bilbao, Vizcaya, Spain
DOREMIRE, LESTER A., Los Alamos, N. Mex.
DYSON, ROBERT L., Council Bluffs, Iowa
EPURE, STEFAN, Los Angeles, Calif.
FREEDMAN, SAMUEL W., Wilmington, Del.
FRITZ, ROBERT J., Schenectady, N. Y.
GARIS, GORDON O., Minneapolis, Minn.
GILES, BILL L., Bartlesville, Okla.
GREENBERG, MURRAY, New York, N. Y.
GRUMPSTRUP, GLEN I., Chicago, Ill.
HARTMAN, GEORGE M., Kew Gardens, N. Y.
HENRY, HAROLD R., East Lansing, Mich.
HOLMES, WILLIAM O., Philadelphia, Pa.
HOOPINGARNER, GEORGE E., Springhill, Ala.
HRUBECKY, HENRY F., Ames, Iowa
HSU, WILLIAM C., Alhambra, Calif.
HURLEY, LAURANCE U., Los Alamos, N. Mex.
HYDE, DONALD J., Mobile, Ala.
KENT, HARRY J., Cincinnati, Ohio
KRUPPEL, AUGUST J., Summit, N. J.
KILBOURNE, CHARLES E., Schenectady, N. Y.
KIMBER, ROGER G., Chicago, Ill.
KINKLE, ROBERT W., Valley Forge, Pa.
KIRK, ARTHUR D., Lake Jackson, Texas
KOBETT, WILLIAM F., Cincinnati, Ohio
KUMAR, NARENDRA, New Delhi, India
LAWRENCE, WILLIAM H., Phillipsburg, N. J.
LEDERMAN, MARVIN, San Francisco, Calif.
LEMON, LEE W., Summit, N. J.
LIPTON, MARTIN H., Verona, N. J.
MANCI, FRANK J., Fairhope, Ala.
MARTINEZ, ARMANDO M., Mexico, D. F., Mex.
MEYER, ROBERT E., Milwaukee, Wis.
MIDDLETON, WILLIAM M., San Mateo, Calif.
MITCHELL, JAMES A., S. Charleston, W. Va.
MOORE, FORREST E., Tulsa, Okla.
MOULD, RICHARD J., Corry, Pa.
NAIFEH, SAM C., Borger, Texas
NICHOLSON, JOHN P., China Lake, Calif.
NOREM, ALLAN G., Murray Hill, N. J.
NOREN, CLYDE W., Brooklyn, Ind.
NYE, DUDLEY D., JR., Bridgeport, Conn.
ODDO, DOMINIC V., Chicago, Ill.
O'ECUYER, FERNAND, Montreal North, Can.
OWEN, FRED R., Sandpoint, Idaho
PAFFRATH, HAROLD H., Bayside, N. Y.
PAIGE, HILLIARD W., Cincinnati, Ohio
PALIT, SUDHANSU S., Calcutta, India
PARKER, DONALD H., North Kansas City, Mo.
PHILLIPS, JAMES S., Spring Hill, Ala.
PRENTICE, MAYO S., Tacoma, Wash.
RANDALL, LINCOLN H., Yokohama, Japan
RANDOLPH, S. WELLFORD, Baltimore, Md.
REICHL, RAYMOND M., Forest Hills, L. I., N. Y.
REUTHER, FRITZ L., Mannheim-Waldhof, Germany
ROCKWELL, WILLARD F., JR., Pittsburgh, Pa.
ROSENBERG, RICHARD, Oak Ridge, Tenn.
ROSSELLE, ROBERT W., Miami, Fla.
RUSTER, HARRY R., Massillon, Ohio
SCHULZ, RICHARD, Johannesburg, S. Africa
SEAR, ERIC F., Mexico, D. F., Mex.
SHAW, RAYMOND R., Chicago, Ill.
SMITH, FRED D., Tampico, Mex.
SMITH, GORDON, Whittier, Calif.
SMITH, HARRY M., JR., Mobile, Ala.
SPENCER, THOMAS N., Amarillo, Texas
STUMM, JAMES E., Cleveland, Ohio
TEN BROECK, EDWARD H., Philadelphia, Pa.
THEOCARIS, PERICLES S., Athens, Greece
THORNTON, WILLIAM D., Los Alamos, N. Mex.
TREXLER, EDWARD C., JR., Richmond, Va.
TRIMBLE, MONROE S., Monroe, La.
ULLMAN, JOHN R., Vancouver, Wash.
VINCENT, KENNETH I. C., Drexel Hill, Pa.
WAHLER, CHARLES H., JR., Brooklyn, N. Y.
WEBSTER, DONALD C., Altadena, Calif.
WILLIAMS, ARTHUR W., Mobile, Ala.
WONG, MANHON, Rutherford, N. J.
WRIGHT, DONALD L., Schenectady, N. Y.

Change in Grading

Transfers to Member, Associate Member, or Affiliate

ARMS, RICHARD P., Cincinnati, Ohio
GALLAGHER, DAVID S., Cincinnati, Ohio
HOLTON, WILLIAM C., Columbus, Ohio
KEYES, JOHN H., JR., Casper, Wyo.
KIPPENHAN, CHARLES J., Kirkwood, Mo.
LANG, ALBERT V., Wyoming, Ohio
LANG, EDWARD H., Syracuse, N. Y.
LEHMAN, BEN J., San Francisco, Calif.
ONOFREY, JOHN E., Johnstown, Pa.
PAGET, JOHN A., Montreal, P. Q., Can.
PEABODY, JOHN E., Miami, Fla.
PHELAN, RICHARD M., Ithaca, N. Y.
REED, KARL F., Erie, Pa.
STEWART, RICHARD B., Boulder, Colo.
SULLINS, SAMUEL L., JR., Oak Ridge, Tenn.

Transfers from Student Member to Associate Member 40

Obituaries . . .

Halford Henry Ambler (1891–1954), mechanical engineer, Charles T. Main, Inc., Boston, Mass., died July 23, 1954. Born, Newark, N. J., June 16, 1891. Parents, George A. and Christine (Millett) Ambler. Education, BS(CE), Massachusetts Institute of Technology, 1914. Married Lillian S. Henderson, 1916. Mem. ASME, 1949. Survived by wife and daughter, J. Meredyth (Mrs. D. S.) Sawyer, both of Winchester, Mass.

Joseph Franklin Carlz (1896–1954), manager, Industrial Marine Division, Standard-Vacuum Oil Company, New York, N. Y., died April 8, 1954. Born, Gloucester, Mass., Feb. 13, 1896. Parents, Joseph and Emily (Melanson) Carlz. Education, ME, Lehigh University, 1918; graduate, Harvard School of Business Administration. Married Gertrude M. Gavel, 1922. Mem. ASME, 1947. Survived by wife; his father; two sisters, Lydia M. and Mrs. Mabel Paz; and brother, Jerry.

Thomas Howard Clark (1924–1954), sales engineer, Western Asbestos Co., San Francisco, Calif., died July 23, 1954. Born, San Francisco, Calif., May 15, 1924. Education, BS(Bus. Adm.) University of California, 1948. Married Janet Thielscher. Jun. ASME, 1953. Veteran, U. S. Army Engineers, 43rd Engineer Construction Battalion, Japan. Survived by wife and three-year-old daughter, Susan.

Bert Fought Downey (1883–1954), secretary-treasurer, The Yost Superior Co., Springfield, Ohio, died recently, according to a notice received by the Society. Born, Sycamore, Ohio, Nov. 23, 1883. Parents, S. F. and Martha Jane (Betz) Downey. Married Minnie Downey; daughter, Betzy Jane. Assoc-Mem. ASME, 1929; Mem. ASME, 1935.

Joseph Horace Drake (1895–1953), associate mechanical engineer, Reynolds, Smith & Hills, Jacksonville, Fla., and an authority on high-pressure steam-generating plants, died Dec. 20, 1953. Born, Battle Creek, Mich., July 28, 1895. Parents, Joseph H., Sr., and Maude E. (Merritt) Drake. Education, AB, University of Michigan, 1916; BS(ME), 1917. Married Zerah Appleton, 1943. Mem. ASME, 1945. Survived by wife; a sister, Mrs. Harold P. Rich, Buffalo, N. Y.; and a brother, Charles M., Birmingham, Mich.

Elliott Ward Gardinor (1906–1954), assistant to general manager and customer-service and production engineer, International Business Machine Corp., Endicott, N. Y., died July 13, 1954. Born, New York, N. Y., April 7, 1906. Parents, Stephen H. and Edna (Fishbaugh) Gardinor. Education, correspondence courses in civil and mechanical engineering, 1929–1932. Married Alice Van Wormer, 1929. Mem. ASME, 1947. Survived by wife; his mother; a sister, Dorothy; and three children, John V., Carolyn, and Lynn.

Ames Bartlett Hettrick (1904–1954), manager of engineering and development, Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J., died early in 1954, according to a notice recently received by the Society. Born, Clinton, Iowa, Nov. 29, 1904. Parents, George D. and Lucy (Bartlett) Hettrick. Education, 4 years, no degree. Massachusetts Institute of Technology, 1924–1928. Married Francis C. O'Brian, 1932. Children, John L., Ames B., Jr., and George H. Assoc-Mem. ASME, 1934; Mem. ASME, 1935.

William Lewis McMeans (1879–1954), mechanical superintendent, Vulcan Mold & Iron Co., Latrobe, Pa., died Feb. 25, 1954. Born, Johnstown, Pa., Oct. 4, 1879. Education, graduate, public schools; evening-school drafting and mathematics courses. Mem. ASME, 1952. Survived by wife.

Jesse George Melendy (1877–1954), retired production consultant, General Chemical Division, Allied Chemical & Dye Corp., New York, N. Y., died June 7, 1954, at his home in Tarrytown, N. Y. Born, Milford, N. H., Sept. 30, 1877. Parents, George L. and Adelaide E. (Burpee) Melendy. Education, PhB, Brown University, 1901. Married Jessie M. Cofran, 1904 (died 1948). Mem. ASME, 1942. Survived by a daughter, Mrs. Freeman T. Putney, Wellesley Hill, Mass.

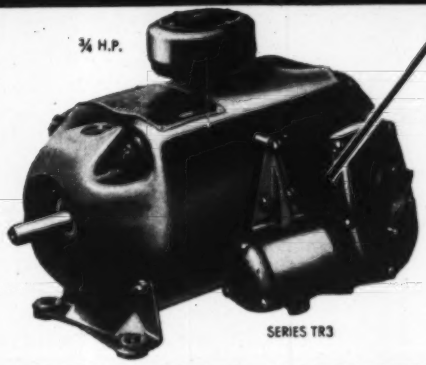
Harry Adolph Schwartz (1880–1954), director of research, National Malleable and Steel Castings Co., Cleveland, Ohio, died July 25, 1954. Born, Oldham Co., Ky., April 13, 1880. Parents, P. F. Adolph and Olga J. J. S. (Koehler) Schwartz. Education, BS(EE), Rose Polytechnic Institute,

(*ASME News continued on page 874*)

18% PRODUCTION INCREASE

Maintenance Practically Eliminated

Winding TV power transformer coils at Sparton Radio-Television



VICKERS

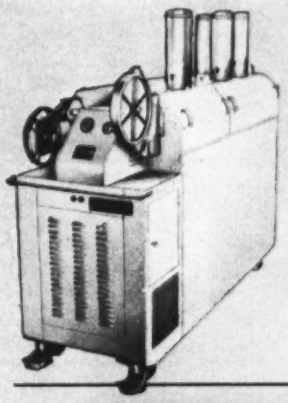
VARIABLE SPEED

Hydraulic Transmission

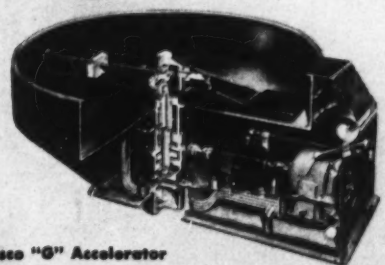
Hourly production was increased 18% when these coil-winding machines at Sparton Radio-Television were equipped with the Series TR3 Vickers Variable Speed Hydraulic Transmission. This improvement resulted from the superior control features inherent in the transmission: (1) extremely quick and smooth variations in speed, (2) maximum torque at low rpm, (3) instantaneous starting and stopping.

While the previous drives required maintenance approximately once a week, the Vickers transmissions have needed attention only three or four times since they were installed four years ago. They have built-in automatic overload protection and they are automatically pressure lubricated by the power-transmitting medium (oil).

Perhaps you have an application where this Vickers Variable Speed Hydraulic Transmission will make similar improvements and economies. Ask the nearest office listed below for Bulletin 47-40a.



Motion Picture Film Processing Machine By Houston Fearless Corp.—Another application where stepless variable speed and constant torque of Vickers Hydraulic Power Transmission provided much more satisfactory operation.



Geniseo "G" Accelerator
A rugged, low cost unit used to calibrate accelerometers and other equipment under operational acceleration forces. Speed settings must be accurate and precisely maintained over extended operating periods. Driven by Vickers Variable Speed Hydraulic Transmission.

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DIVISION OF THE SPERRY CORPORATION
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6486

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

1901; MS, 1903; ME, 1905; ChE, 1931; hon. DS, 1933; hon. DE, Case Institute of Technology. Married Alice Joy Hill, 1918. In 1939 he was recipient of E. J. Fox medal, Institution of British Foundrymen; in 1951, Charles H. McCrea medal, Malleable Founders' Society. Held 10 patents dealing with malleable processes. Jun. ASME, 1907; Mem. ASME, 1913. Served the Society on the Joint Committee with AFA on Shop Practice. Author of "American Malleable Cast Iron" and some 40 articles published in the technical press. In 1947 he was made honorary member of the Belgian Society of Foundry Technique. Survived by wife.

George Thomas Trundle, Jr. (1884–1954), founder and chairman of the board, The Trundle Engineering Co., Cleveland, Ohio, died July 16, 1954. Born, Uvilla, W. Va., Sept. 26, 1884. Parents, George T. and Georgianna (Moler) Trundle. Education, high school; YMCA and Central Institute courses; ICS. Married Ida May Christner, 1906. He received the Taylor Key in 1937; and was also awarded the certificate of award by the Industrial Engineers Association; Award of Merit, Construction Battalions, U. S. Navy; Award for Meritorious Service, Smaller War Plants Corporation. Mem. ASME, 1941. Survived by wife and two children, Robert C., Cleveland, Ohio; and Miriam Wackerman, Chagrin Falls, Ohio.

James Van Buskirk (1887–1953), industrial specialist, Quartermaster Department, U. S. Army, died Oct. 18, 1953, in Grand Rapids, Mich. Born, Buffalo, N. Y., Sept. 6, 1887. Parents, Homer and Emma (Hutton) Van Buskirk. Education, graduate, Rochester Mechanics Institute, 1907; special courses, University of Rochester, 1908. Married Mary Jane Kearns, 1919 (died 1947). Mem. ASME, 1945. He held a patent on self-action line splice (automatic) for splicing electric power-line wires. Received Merit Award from Ordnance Department for improved design of ordnance materials. Survived by son, James, Jr., Evanston, Ill.; and daughter, Mrs. O. E. Gram, Billings, Mont.

David Spencer Wegg (1887–1954), engineer, Charles T. Main, Inc., Boston, Mass., died June 24, 1954, at his home in Wellesley, Mass. Born, Milwaukee, Wis., Feb. 8, 1887. Parents, David S. and Eva (Russell) Wegg. Education, ME, Cornell University, 1912; MME, 1914; MS(Mining), University of Utah, 1915. Married Dorothy Vedder, 1914; married 2nd, Betty Fellows, 1928; and married 3rd, Mildred Randell, 1939; children, Dorothy (Mrs. G. Walker) Morgan and Helen, both of Chicago, Ill. Jun. ASME, 1909; Assoc. Mem. ASME, 1914; Mem. ASME, 1921. He served the Society as secretary of Power Test Codes Subcommittee No. 11, on Complete Power Plants.

Herman Weisberg (1900–1954), mechanical engineer, Public Service Electric and Gas Company, Newark, N. J., died June 29, 1954, at Johns Hopkins Hospital, Baltimore, Md. Born, New York, N. Y., May 11, 1900. Parents, Mr. and Mrs. Samuel Weisberg. Education, ME, Cornell University, 1921. Mem. ASME, 1937; Fellow ASME, 1953. He was active on many ASME committees and had contributed in a marked degree to the advancement of principles which have been incorporated in various standard codes. Author of several papers which were published in leading scientific and technical journals. A widower, he is survived by a daughter, Joan; a son, Peter; his father; two brothers, Dr. Irving Weisberg, Nanuet, N. Y., and Daniel Weisberg, Kingston, N. Y.; a sister, Rose, Washington, D. C.

Herbert Lucius Whittemore (1876–1954), retired chief, engineering mechanics section, National Bureau of Standards, Washington, D. C., died July 11, 1954. Born, Milwaukee, Wis., Oct. 1, 1876. Parents, Lucius L. and Charlotte E. (Hanson) Whittemore. Education, Pratt Institute; BS(ME), University of Wisconsin, 1903; ME, 1910. Married Elizabeth A. Kittredge, 1923. Jun. ASME, 1903; Mem. ASME, 1910; Fellow ASME, 1936. He was extremely active in Society affairs, serving on several technical committees; as chairman of the Washington, D. C., Section; as Manager, ASME, 1930–1933; as a member of the Nominating Committee, 1938; and for many years as member of the Committee on the Economic Status of the Engineer. During his years with NBS he invented testing equipment, including the Whittemore Fulcrum Plate Strain Gage to measure stress on concrete dams and large steel structures. He also helped invent the Whittemore-Petrenko proving ring, which has become standard equipment for checking the accuracy of tension, and compression-testing machines. He was the author of books and pamphlets in his field, including "Ideas on Specifications," which was published commercially in 1952. He received the James T. Morehead Medal, 1927, from the International Acetylene Association; and the Longstreth Medal, 1938, from The Franklin Institute for his inventions. Survived by his wife, E. A. Kittredge, MD; a son William K., Cleveland, Ohio; a daughter, Nancy; and a sister, Mrs. Anne Von Ammon, Washington, D. C.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

ASME Master-File Information

(Not for use of student members)

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Home address ..... ☐ (Street, City, Zone, State)

Name of employer .....

Address of employer ..... ☐ (Street, City, Zone, State)

Product or service of company .....

Title of position held .....

Nature of work done .....

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Publication	*Address changes effective when received prior to:*
☐ MECHANICAL ENGINEERING	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Please register me in three Professional Divisions as checked:

☐ A—Aviation
☐ B—Applied Mechanics
☐ C—Management
☐ D—Materials Handling
☐ E—Oil and Gas Power
☐ F—Fuels
☐ G—Safety
☐ H—Hydraulics
☐ J—Metals Engineering
☐ K—Heat Transfer
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Four words . . . but every time they appear on an order, Flexitallic salutes an engineer who has joined the crusade for one standard of quality in gasket construction.

Flexitallic Spiral-Wound identifies the original spiral-wound gasket—the standard of quality in high-pressure, high-temperature seal for more than 40 years.

Spiral-wound is the proper designation of a gasket that compresses like a spring to make an effective seal, compensates for unpredictable joint stresses, and then rebounds when the bolt load is relaxed.

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FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

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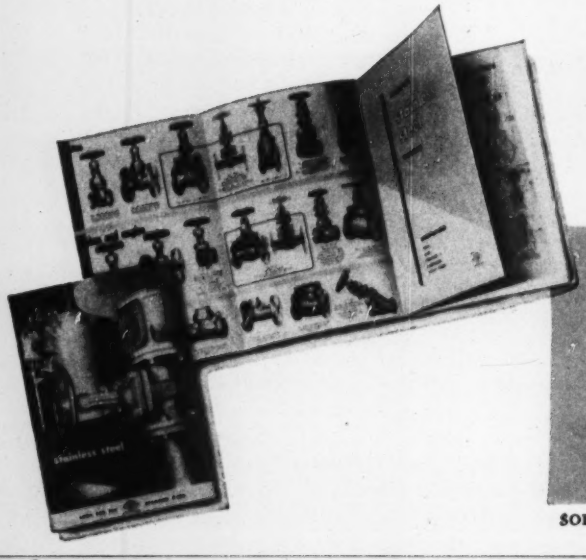
Trim costs with this hook-up for valve-killing corrosive services

To end high valve mortality from most corrosive liquids, and to control fluids that must be kept free from contamination or discoloration, stainless steel is the right metal. But it takes more than metal to make a valve. For dependable performance, you need the two-way hookup — Stainless Steel *and* Jenkins time-proved Valve Engineering.

With the increased demand for processing equipment that resists corrosion, more and more Stainless Steel Valves have been added to the Jenkins line. It now includes types, designs, sizes and alloys to meet practically all industrial needs.

Let the famous Diamond trade-mark be your guide when you choose valves of stainless steel. As on *any* Jenkins Valve, it means *extra value* . . . longer, trouble-free service life.



NEW BOOKLET describes the wide range of types, sizes, pressures, and alloys available in Jenkins Stainless Steel Valves, with diagrams and dimensions. Includes description of alloys, helpful information on selection, and survey forms. Ask for Form 200. Jenkins Bros., 100 Park Ave., New York 17.

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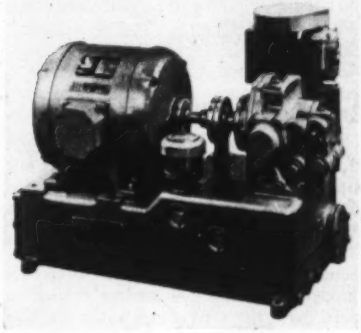
Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT

New Tracing Materials

Cross sectional grids printed in non-reproducible ink on various grades of tracing papers and tracing cloths have been introduced by John R. Cassel Co., Inc., 110 W. 42nd St., New York 36, N. Y. The new material can be obtained in rolls 30 in. wide from the company.



Variable Delivery Pumps

For variable speed straight line and rotary drive applications requiring 1 to 3 hp under precise speed or pressure control, Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis., is building a complete new line of one- and two-way variable delivery pumps.

The company says each pump is a complete package unit incorporating a variable delivery, high pressure, radial piston pump with patented, balanced flat valve; a constant delivery, low pressure gear pump (small and large size); one of eight standard controls; a three-way suction and return valve for differential systems; dual disk type check valves for non-differential systems; a double acting high pressure relief valve and a gear pump relief valve.

Compact hand-screw, hydraulic servomotor lever, automatic adjustable pressure unloading, hydraulic remote, electric remote, electric-hydraulic servo and pneumatic controls mount on either side of the pump case. The pumps can be mounted on reservoirs integral with machines or furnished with standard oil reservoirs for mounting both pump and electric drive motor.

Aluminum Electrode

To provide maximum weld quality in the inert-gas, shielded arc welding of aluminum, Aluminum Co. of America, 738 Alcoa Bldg., Pittsburgh 19, Pa., has developed a new high quality welding electrode.

According to company engineers, the new consumable electrode, which was produced to achieve weld soundness as required in Navy specifications for this type of product, is expected to set a new standard of quality for inert gas welding of aluminum.

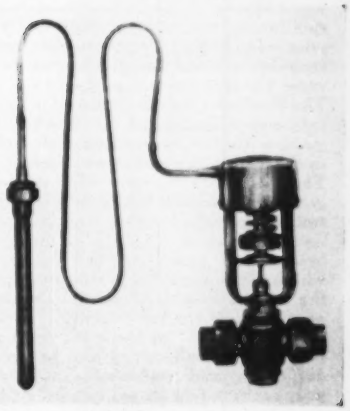
The new electrode was designed to be used in the welding guns employed with existing consumable electrode, shielded arc processes, and can also be used for tungsten-arc welding where the filler wire is fed mechanically to the work. The new electrode is currently being produced from three aluminum alloys—2S, 43S and A54S. It is packaged and stocked on non-returnable fibre spools in the following wire sizes: .030 in., .040 in., $^3/_{64}$ in., $^1/_{16}$ in., $^3/_{32}$ in., and $^1/_8$ in. diameters. In addition to these standard sizes, mill quantity orders are available in all wire sizes from .020 in. to $^1/_8$ in. Tolerance on these diameters are plus .001 in. to minus .002 in. Each spool contains 10 lb of wire level wound in one continuous length. The spools are individually carton packaged.

The electrode conforms with American Welding Society specification A5.10-54T (tentative 3/17/54) and ASTM specification B285-54T.

Moisture Trap

A new Anderson No. 81 float-type moisture trap designed to fill the need for a simplified, low cost, float trap on air, gas and steam applications has been announced as available from the company. The unit has good capacities for its size and is designed as a low cost method of draining moisture and condensate continuously and automatically from piping systems, Hi-eF purifiers and other equipment which handle air, gas or steam. They are said to be suitable for operating pressures up to 200 psig and have the unique feature of an optional inlet for ease of installation.

The trap consists of a stainless steel valve and seat, and lever, plus a copper hide float inside a cast semi-steel case. A stainless steel float can be furnished when specified. The valve is opened by liquid raising the float and closed when float drops the liquid level. The traps are furnished with either $^1/_2$ or $^3/_4$ in. connections. Additional information may be obtained from V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.



Temperature Regulator

Fulton Sylphon Div. of Robertshaw-Fulton Controls Co., is marketing an industrial temperature regulator, No. 999, designed to meet a wide variety of conditions. It has 24,640 standard combinations, the company says, including combinations of available valve sizes, valve types, temperature ranges, bulb types and materials.

Company engineers say the regulator is used to control temperature of internal combustion engines, storage water heaters, bottle washers, and a variety of other equipment and for industrial processes requiring accurate temperature control, particularly in the chemical, pharmaceutical, food processing, leather and textile fields.

The regulator is self-powered, and requires no compressed air, electricity or other outside source of energy. The frame is stainless steel. A large, two-ply, seamless metal, sylphon bellows provides long life. Over-temperature protection is a standard feature.

Applications of cathode-ray oscillography

FATIGUE TESTING

The Physical Setup: **The connecting rod for an internal combustion engine is held in an electro-mechanical resonant system which imparts reverse bending stresses to the rod.**

The Problem: **To measure and maintain surveillance of the dynamic stresses in the connecting rod and to determine the endurance limit.**

The Solution: **Electric wire strain gages are attached to the connecting rod in the critical region and, in connection with a suitable electrical bridge and amplifier, the output, which is proportional to the stress in the rod, is displayed on the screen of a cathode-ray oscillograph,* and photographed** at intervals during the test. By calibrating the bridge, amplifier, and cathode-ray oscillograph, the stress in psi can be read directly from the screen of the oscillograph as the vertical deflection at any instant.**

Since the fatigue test may continue to several million complete stress cycles, surveillance of stress level can be maintained by observing the continuous pattern on the cathode-ray oscillograph. Incipient failure by fatigue results in a decreasing natural frequency of the electro-mechanical system. Therefore, incipient fatigue can be detected by connecting the strain-gage output voltage to the Y-axis and the output of a stable oscillator at the natural frequency of the connecting rod to the X-axis of the cathode-ray oscillograph. Under normal conditions, with no fatigue, and the output of the strain gage and oscillator properly adjusted, the standing circular pattern shown will be observed. As the connecting rod starts to fatigue, the change in frequency of the mechanical system will cause this circular pattern to cycle at a rate equal to the change in frequency, thus indicating the rate of fatigue in the part. Furthermore, failure in the connecting rod in the region of the strain gage will show up distinctly as a distortion of the pattern from a circle or ellipse. This pattern distortion is often a more sensitive indication of incipient failure.

An important application of cathode-ray oscillography by the Motor Truck Division, International Harvester Company, Fort Wayne, Indiana.

Du Mont Type 304-A ** Du Mont Type 296

DU MONT *for Oscillography*

For further information concerning the Du Mont instrument used in this application, contact:

ALLEN B. DU MONT LABORATORIES, INC.

Technical Sales Department, 760 Bloomfield Avenue, Clifton, New Jersey

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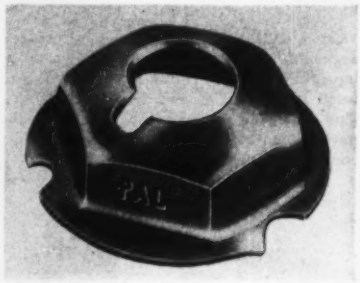
Steel Cage Roller Bearing

A steel cage type roller bearing which is a self-contained unit and can be used without an inner or outer race is manufactured by Rollway Bearing Co., Inc., a subsidiary of Lipe-Rollway Corp., Dept. STC, Syracuse, N. Y. The bearing can be used directly on a hardened shaft or sleeve and in a hardened housing, and can be installed directly in the bores of hardened gears or housings of extremely limited boundary dimensions. By running directly on a hardened shaft, the bearing can support fairly heavy bearing loads. Hardened and ground steel cage bearings of this type range in bore sizes from $^3/_8$ in. to 4 in.



Grounding Lock Nuts

The Palnut Co., 61 Cordier St., Irvington 11, N. J., now offers its washer type lock nut with toothlike elements in the flanged base to dig through non-conducting materials to achieve an electrically grounded assembly.

Originally developed for automobile manufacturers for grounding lamp assemblies through non-conductive coatings present on metal parts, this type of lock nut is available for other assemblies where grounding or intimate contact through digging of metal is desired. The lock nut and flat washer are in one piece and exert a double locking spring action on the screw threads, as the teeth of the washer engage the metal seat. Available in No. 10–24 and $^1/_4$ in.–20 sizes. Samples are available from the manufacturer.

3000 PSI Check Valve

A new line of hydraulic check valves has been designed and introduced by Rivett Lathe and Grinder, Inc. The 3000 ps valve allows free flow in one direction and prevents flow in opposite direction.

The new valve features large area which permits unusually large volume. For example, the $1^1/_2$-in. valve has a 104.2 gpm capacity at 15 fps. The new line of valves may be secured with pipe thread or flange connection; spring closed or pilot operated. In $^1/_4$ to $1^1/_2$-in. size mounting may be made in any position.

Model 8640 is spring closed; Model 8642 is pilot operated and Model 8644 is pilot operated with pressure breaker. Information is available from Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass.

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NEW EQUIPMENT
BUSINESS NOTES
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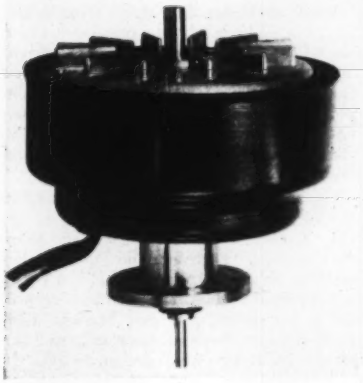


Synchronous Motors

A new series of low and high speed direct-drive synchronous motors is now available from Technical Development Corp., 4060 Ince Blvd., Culver City, Calif. The series features synchronous speeds from 300 rpm to 1800 rpm.

Combining a high torque rotor with flywheel and precision ground capstan, the motors are said to provide accurate and constant tape velocities for magnetic recorders without gear reductions. Standard capstans presently available and the large variety of motor speeds provide tape velocities of $1^{7}/_{8}$, $3^{3}/_{4}$, $7^{1}/_{2}$, 15, and 30 in. per sec. Special features such as extended or double-ended shafts, variations in mounting details, direction of rotation, line voltage and frequency are available on request.

All motors are supplied with a magnetic shield eliminating the high-torque flux field from the region of the capstan. Twelve cooling impellers located on the flywheel-rotor provide ventilation with maximum space conservation.

Motors are reversible and supplied with single or dual speed windings. A series of 50 cycle motors as well as the standard 115 volt, 60 cycle line are also available.

The motors measure approximately $5^{7}/_{16}$ in. in diameter and extend $4^{19}/_{32}$ in. from the mounting surface. Mounting is accomplished by a four hole flange.

Engine Hand Clutch

A hand clutch has been developed for the 26.8 H. P. Kohler K660 air-cooled engine, the Kohler Co., Kohler, Wis. announces. The wet type, lever operated clutch, designed to engage at all engine speeds, is mounted on anti-friction ball bearings.

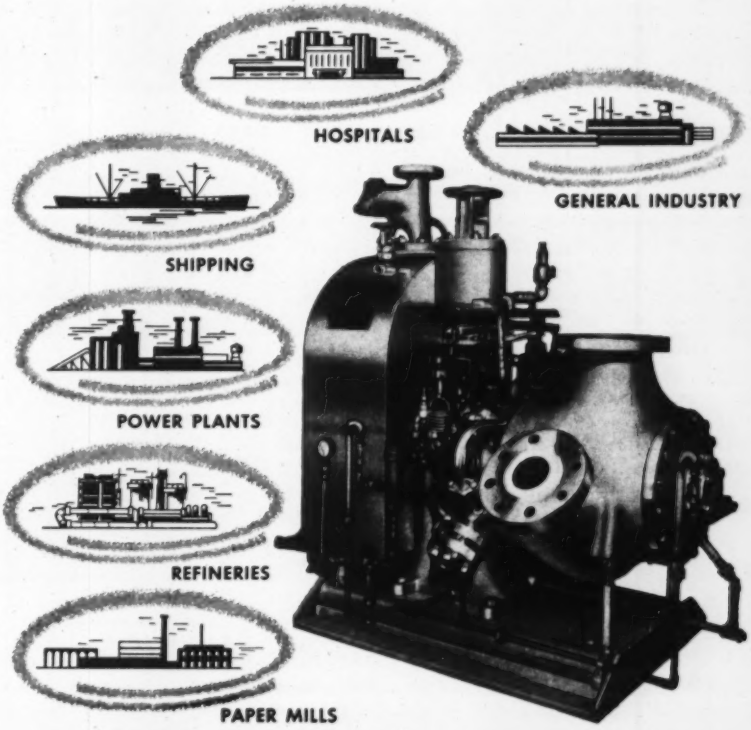
This latest 2-cylinder opposed model carries a number of standard features including a silencer-type muffler, automotive diaphragm type fuel pump, oil bath air cleaner and oil pressure gage. A specifically designed air cooling system keeps the four-cycle, heavy duty engine at correct temperatures under all operating conditions.

VERSATILITY!

ENGINEERED FOR OUTSTANDING PERFORMANCE IN MANY OPERATIONS!

On board ship, in refineries, hospitals, public utilities—in paper, textile and all general industry, the Coffin line of turbo equipment is earning nation-wide acceptance for outstanding performance. Designed with versatility in mind, latest addition to the line the Coffin "DE" Turbo Pump has a Volumetric Range to 800 GPM, Discharge Pressures to 1500 psi, Steam Temperatures to 850° F., Exhaust Pressures to 80 psig, and Liquid Temperatures to 325° F. Ratings can be exceeded in special installations.

Engineers! Write today for complete specifications. Ask for "DE" Bulletin G-101.



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THE J. S. COFFIN, JR. COMPANY
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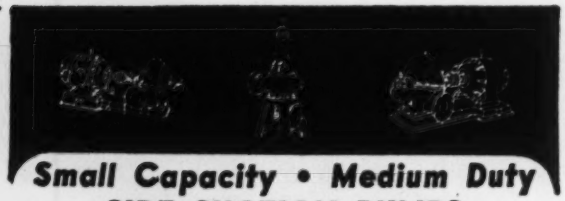

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Close-Coupled • Flexible Coupling • Belt Drive

CAPS 5 to 75 G.P.M.

HEADS 0 to 100 ft.

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Type JMC Aurora Close-Coupled Pump

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- Microwave Filters
- Flight Simulators
- Subminiaturization Techniques
- Electro-Mechanical Design
- Small Mechanisms Design

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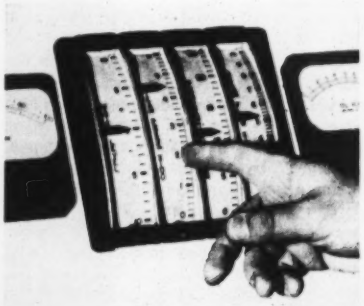
KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Vertical Speed-Reduction Units

American Pulley Co., 4200 Wissahickon Ave., Philadelphia 29, Pa., announces a new line of Shaft-King speed-reduction drives available for mounting in a vertical position. The speed reducers are shaft-mounted units designed for applications where the driven machine shaft is in a vertical position or nearly so, such as on mixers, agitators and liquid processing machines.

The units can be supplied in 13 to 1 and 20 to 1 ratios for requirements through 42 hp. They feature helical gears cut from alloy-steel forgings. Both ball and tapered-roller bearings are used. Also featured is a three-wall, internally-ribbed cast-iron housing providing permanent gear and bearing alignment, and extra-large oil reservoir, as well as a patented concentric-shaft design.

The units can also be supplied with a torque-arm overload release which is said to give complete protection to the driven machine, motor and drive, for operations where jam, choke, or shock loads may occur.



Remote Indicator

A miniature remote indicator which has a 5-in. useable scale, but is easy to read, is now in production at The Hays Corp., Michigan City, Ind. Among the indicator's features are removable units; one-man zero adjustment; no parallax; internal illumination; and flush or semi-flush panel mountings.

The indicator can be supplied as an electric or pneumatic receiver for the measurement of any function such as pressure, draft, flow, level, or temperature. The pneumatic type gage uses as its actuating element a spring-loaded metallic bellows with built-in overpressure protection. The gages can be provided with two units in a single case and two pointers on the single scale.

A direct reading gage, using a bourdon tube as the actuating element, is available for indicating pressures of fluids. The electric model uses as its operating mechanism a specially designed motor, electronic amplifier, and a pair of differential transformers (one at the transmitter, the other at the indicator) forming an electric null balance circuit. Transmitters for pressure, draft, temperature, flow, and level are offered. Publication 54-1075-223, describing the indicator, is available from the company.

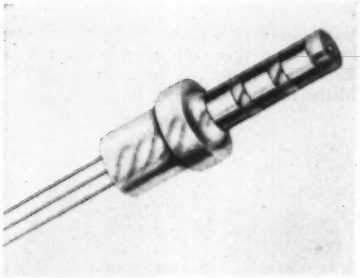
KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Corrugated Roofing

New, opaque gray sheets of polyester-fiberglass corrugated roofing and siding sheets have been announced by Resolite Corp., Zelienople, Pa., as an answer to the problem of corrosion due to chemical and acid fumes.

The company says selection of the new sheets for installation in a chemical plant and a galvanizing plant were made on the basis of a test in which samples were immersed in a 3 per cent solution of sulfuric acid for three months. The fiberglass reinforced polyester resin sheets showed no appreciable structural change, while other roofing sheets lasted up to two weeks for the most effective type and only a few days for the least effective, the company says.



Slip Ring Assemblies

Electro Tec. Corp., South Hackensack, N. J., has announced the development of an insulation material for high temperature slip ring assembly applications.

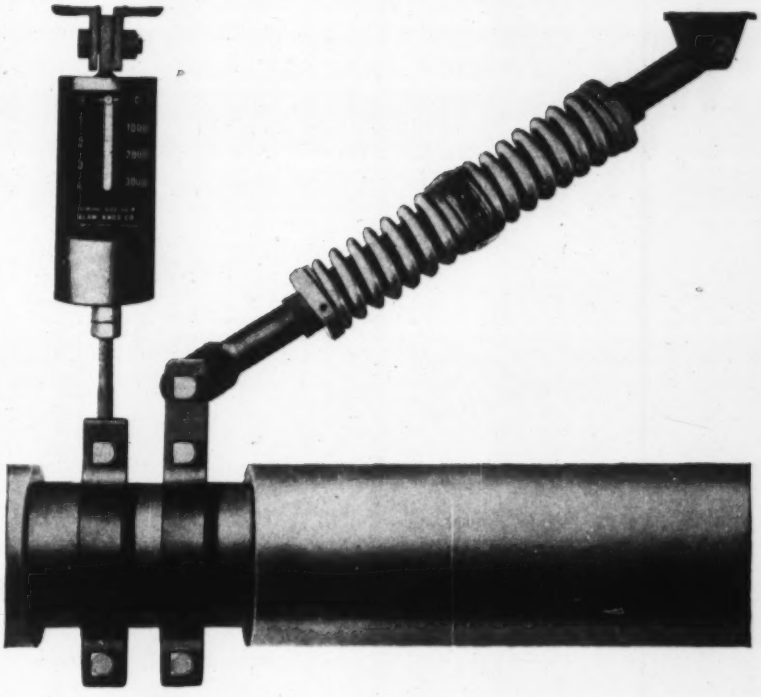
The manufacturer is currently manufacturing units with its new Plastic, ETC-7, which is said to withstand −60 F to + 500 F and has low water absorption, high surface resistivity, and excellent impact strength and dielectric properties.

Air Conditioning

Two new central air conditioning units for domestic and light commercial applications have just been announced by Iron Fireman Mfg. Co., Cleveland 11, Ohio.

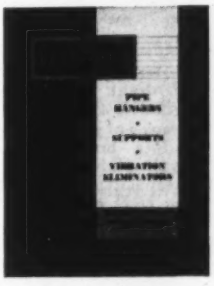
One unit, designed to match the company's Highboy oil or gas furnace, is available in two-ton capacity. An inlet air opening is provided in the side panel for connection with a warm air furnace or with a return duct if no furnace is involved in the installation. The second unit is especially designed to be used in combination with oil-fired or gas-fired suspended furnaces. This unit is built in two-ton and three-ton sizes. Air circulation and filtering are provided by the furnace, or by a separate blower if the unit is installed by itself.

Both the Highboy cooling unit and the horizontal duct cooling unit are available with or without cooling towers. The company says their hermetically sealed cooling systems are guaranteed for five years, and that both units may be ordered with either single phase or three-phase compressor motors.



complete hanger units cut your field erection costs

One sure way to cut your field erection costs is to use Blaw-Knox hangers and eliminators. Each is a complete packaged unit, ready to install. No expensive cutting, threading and assembling on the job. And you'll also save on engineering and specifying time.



Each Blaw-Knox functional spring hanger, rigid hanger assembly, overhead roller assembly, and vibration eliminator is designed for a specific purpose. Constructed to conform with the "code for pressure piping." Available in types and sizes to meet varying conditions.

Any time you'd like some help, our experienced engineers are available to both design and make recommendations for your hanger requirements. Send for your copy of Bulletin No. 54 to get full information.

BLAW-KNOX COMPANY, Power Piping and Sprinkler Division, Pittsburgh 33, Pa.

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PIPE HANGERS

Complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators . . . plus complete prefabricated power piping systems for all pressures and temperatures.

What's NEW in pumps from

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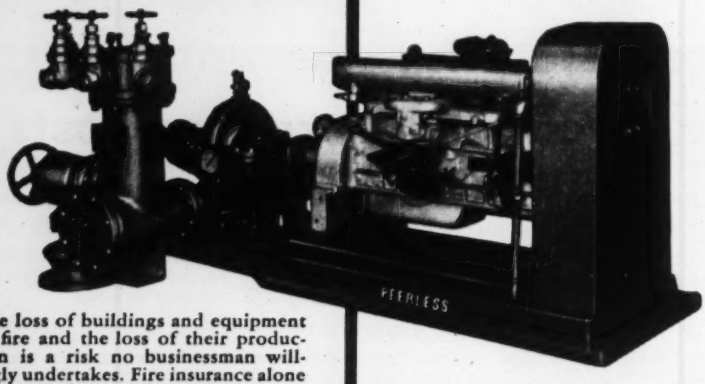
NEW SIZES OF APPROVED FIRE PUMPS ...provide the complete line of all ratings for all risks



The loss of buildings and equipment by fire and the loss of their production is a risk no businessman willingly undertakes. Fire insurance alone does not adequately cover losses from disastrous fires. The best assurance of adequate safety and satisfaction in any and all commercial and industrial risks, Peerless believes, is a combination of:

1. Top quality fire pump equipment.
2. Exacting engineering application.
3. Conscientious installation service.

Peerless underwriters' approved fire pumps and Peerless engineering and application service completely cover every installation requiring fire protection service. Primary uses are to provide water for stand pipe, automatic sprinkler and hydrant systems. New Peerless pump models afford the most comprehensive range of types and sizes available, including both horizontal and vertical, single and two-stage designs providing capacities and pressures to squarely meet *every* requirement of the underwriters.

Peerless Pumps are pre-eminent in the field of fire protection. Their name is a synonym for pump quality and operational dependability.

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Write for a 24-page full-color bulletin describing and illustrating Peerless fully approved fire pumps. Mail the coupon today.

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PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
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Please send Fire Pump Bulletin B-1500

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Press Fit Bearings

The recently announced Link-Belt line of mill bearings has been augmented to include pillow blocks with heavy-duty self-aligning roller bearings for press fit on shafts. These are designed for use in steel mills and other heavy industries.

The new series LPK7800F bearings have steel split housings, and caps and bases are secured with four extra-heavy bolts and large dowels. Company engineers say the Press fit of bearings on machined shafts assures positive concentric mounting, and locknuts and lockwashers assure positive location. With shafting machined as recommended, full capacity rating of the self-aligning, self-contained double row roller bearing is also assured. The bearings are available in bore size range of 3.1496 in. to 7.4803 in. Additional information about dimensions and load ratings is available in Link-Belt Book 2565A, available from the company, 307 N. Michigan Ave., Chicago 1, Ill.

Planetary Transmission

A new compounded double planetary type transmission of 150 lb-ft input torque for use with a torque converter having a 2.12 multiplying factor has just been placed on the market by the American Gear & Mfg. Co., Lemont, Ill., subsidiary of Brad Foote Gear Wks., Inc., Cicero, Ill.

Designed for fork lift trucks, hoists, cranes, car pullers, slushers, truck mixers, earth movers, machine tools, the PGT-150 Plan-Gear transmission can be shifted from any place convenient to the operator but with complete disregard to location of the transmission, from full speed forward to full speed reverse, in only $1\frac{1}{2}$ seconds without vibration or jerk, according to the company.

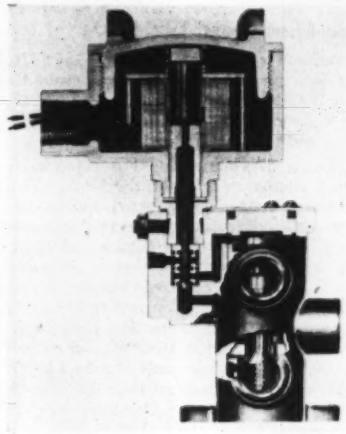
The shift in the unit is made by contracting or releasing the heavy bands of the two planetary systems. A cushioning effect is achieved when oil is squeezed from the area between band and anulus or drum. Hydraulic pressure for actuating controls, internal lubrication, and flow to torque converter is supplied by a built-in oil pump. This pressure is used to contract the bands while spring pressure returns them to open positions. High speed forward is obtained by driving through a built-in, hydraulically actuated multiple disk clutch.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Complete control of the transmission is accomplished by moving a single hydraulic valve lever. Because all gears of the two planetaries are always in mesh, no damage to the transmission results from willful abuse or careless manipulation of the control lever. Operator can switch the hydraulic pressure at any speed, at any time, to any position, to start, to neutral, or to vary speed or direction. Ratios are: 1:1 in high, 3:1 in low, and 3.2:1 in reverse. Optional reverse is 2.23:1.

Power take-off apertures on both sides of the transmission provide sources of power for performing secondary functions of the driven machine.



Solenoid Air Valves

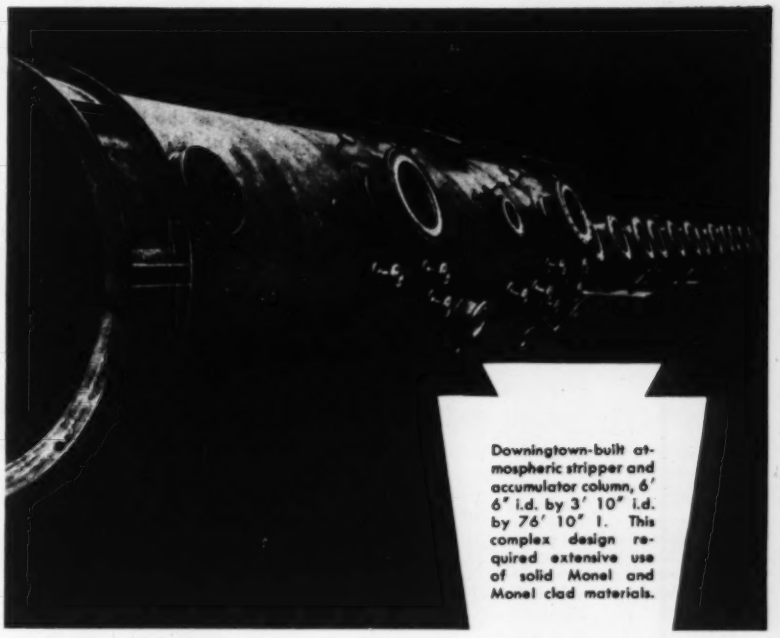
Explosion-proof solenoid air valves which feature an extremely short solenoid stroke have been introduced by Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif.

Company engineers say that this feature in conjunction with pilot operation eliminates the problem of coil burn out. Poppet design with linear sealing contact on resilient seats is said to make both the pilot and main valve self-scavenging. The cover of the explosion-proof housing is removable for quick access to the solenoid, and the coils are interchangeable, the company says.

Bucket Steam Trap

A bucket steam trap, manufactured under the trade name, UNI-TRAP, employing a balanced valve principle, and automatically operating through complete pressure ranges up to 250 psi without adjustments, changing orifices, or valves has been introduced by Perfecting Service Co., 332 Arando Ave., Charlotte, N. C.

The new trap is made in two styles, the standard, bottom inlet and top outlet type, and the in-line unit, that can be repaired without removing from steam line. All internal parts are made of stainless steel, valves and valve seats are 500 Brinnel hardness. Available in pipe sizes $\frac{1}{2}$ through 2 in. Write for catalog No. 800 to the company.



Downingtown-built atmospheric stripper and accumulator column, 6′ 6″ i.d. by 3′ 10″ i.d. by 76′ 10″ l. This complex design required extensive use of solid Monel and Monel clad materials.

No Design Too Complicated

Order plate fabrication from Downingtown Iron Works. That's the easy way to turn your complex designs into smooth-working process equipment—the sure way to be sure of skillful workmanship in every detail.

Downingtown is thoroughly experienced in fabricating pressure vessels from various grades of carbon steel, stainless steels, nickel clad, stainless clad, Monel clad, cupro nickel, aluminum and other materials. We've developed special welding procedures—approved by ASME for code work—which enable us to produce sound welds which are extra strong and extra neat. Welds are X-ray inspected as required.

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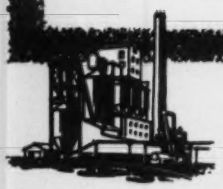

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WISCONSIN HEAVY-DUTY *Air-Cooled* ENGINES

In 1953 a leading Design trade magazine conducted a survey among 1902 manufacturing plants on the use of Internal Combustion Engines of less than 60 hp., as power components in equipment made for resale.

Projected returns from 42.6% of plants contacted showed an estimated 678 plants using engines in the stated category, representing total engine purchases of 2,727,216.

Answering the question: "Who makes the Internal Combustion Engines you Use?" . . . Wisconsin Motor Corporation received 132 mentions, as against 105 for the second place builder, 56 for No. 3, 51 for No. 4—in a list of 41 classified engine manufacturers.

This outstanding preference for Wisconsin Heavy-Duty Air-Cooled Engines (although limited to a power range of 3 to 36 hp. in a broad survey classification including ALL engines below 60 hp.) provides tangible evidence that "WISCONSIN" rates first among men who know engines best. We'd like to count you among them.

Power TO FIT THE MACHINE

WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

Flow Regulator

Waterman Engineering Co., 725 Custer Ave., Evanston, Ill., announces the development of a new constant flow regulator with an automatic by-pass feature. The company says constant rate of flow can be maintained regardless of variation in pressure or back pressure while simultaneously bypassing excess pump output at working pressure.

The regulators are recommended by the company for power steering systems, fluid motors, or any hydraulic system where constant flow is required in the presence of varying pump output. An illustrated circular with graphs may be obtained from the company.

Split-Microsecond Timer

An 8-mc counter chronograph, Model 471, has been introduced by Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y., to meet the demand for field testing sonar and radar equipment.

Housed in two drip-proof heavy-gage reinforced aluminum cabinets, the Model 471X contains a temperature-compensated crystal-controlled 8-mc oscillator that produces timing pulses exactly $\frac{1}{8}$th microsecond apart. The company says these pulses are gated into a high-speed electronic counter during an unknown interval. Upon completion of a measurement, neon lamps give direct indication of the exact number of microsecond and eighths of microseconds contained in the interval. Results may be observed visually or applied to a recorder or printer which is also available from the manufacturer.

Maximum interval range is 1 second and measuring accuracy is $\pm\frac{1}{8}$ microsecond. Special highly-stable counting circuits assure complete reliability of counts. The cabinet shown on top in the photo contains the 8-mc crystal oscillator, the electronic counter stages and the necessary control circuits; the bottom cabinet houses the three separate power supplies employed.

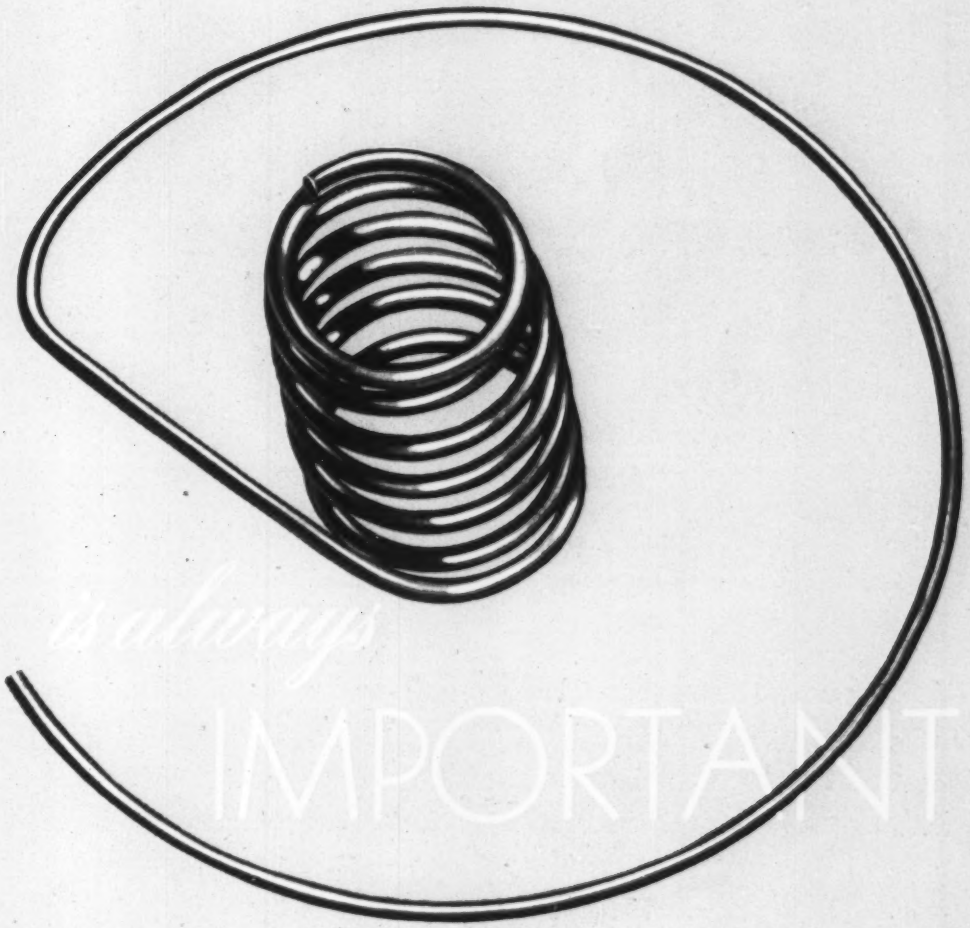
Pulses defining time intervals to be measured may be applied on separate lines or on a common line. A lockout arrangement prevents pulses other than those intended for starting and stopping from affecting the instrument, thus making it possible to time intervals between two pulses occurring in a repetitive train. With a high-speed recorder or printer the 471X recycles for another measurement as soon as one reading is recorded.

Packaged Boilers

Mears-Kane-Ofeldt, Inc., Div. of S. T. Johnson Co., announces that it is shipping its new MKayO combination oil and gas boilers. The combination boiler can be used to great advantage wherever there is a reduced interruptible gas rate available, the company says additional information can be obtained from the manufacturer, Church Rd., Bridgeport, Pa. Sales Office: 108-22 Queens Blvd., Forest Hills 75, N. Y.

Continued on Page 53

a SPRING



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10 PROVEN SOURCES COAST TO COAST

IN CANADA - The WALLACE BARNES CO., Ltd., Hamilton, Ontario

SEE OVER

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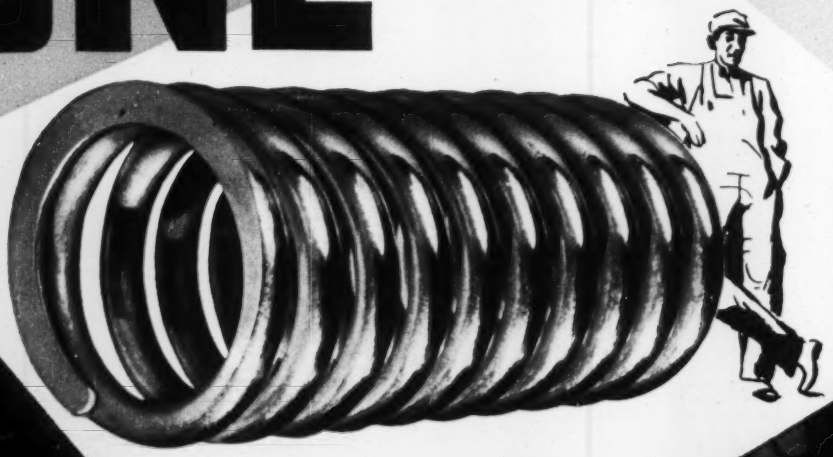

or a MILLION

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IN CANADA - The WALLACE BARNES CO., Ltd., Hamilton, Ontario

WELDED DESIGN REDUCES VIBRATION CUTS COSTS

CONTRARY to traditional belief, high-speed machinery like printing presses can be made from welded steel to run faster, smoother with minimum adjustment for register. Savings in cost are up to 50% compared to former cast designs.

This 75-foot welded steel press built by Goss Printing Press Company for a popular magazine publisher runs at 11,500 impressions per hour compared to 4,000 by the press it replaced. Yet, vibration is less, make-ready is faster, fewer adjustments are needed.

The housing for the folder frame on this Goss Printing Press (Figure 1) previously weighed 405 pounds . . . cost $683.00. The welded steel frame weighs only 300 pounds, costs only $123.00 . . . *an 84% reduction in cost.*

The folder bed plate (Figure 2) was a 4,113-pound casting and cost $1,725.00 to cast and machine. The welded bed plate now used weighs 3,000 pounds and costs only $248.00.

Fig. 1. Saves $560.00 per frame *by converting to welded steel design. Weight is cut from 405 to 300 pounds per frame.*

Fig. 2. Saves 1,113 pounds. *cost down 86% on press folder bed plate.*

HOW TO DESIGN FOR LOW COST

Machine design sheets showing how to simplify design, save metal and cut costs are available to product engineers and designers by writing on your letterhead.

THE LINCOLN ELECTRIC COMPANY

Dept. 4805, Cleveland 17, Ohio

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

KEEP INFORMED

Cylindrical Strainer

A new cylindrical type strainer employing a wire mesh basket has been announced by Wm. W. Nugent & Co., Inc. It is designed for heavy oils and other viscous liquids and, according to the company can be used with any liquid that does not affect steel or stainless steel.

The strainer is available in nine sizes, ranging in capacity from 6 gpm up to 7050 gpm when handling oil of 100 SSU viscosity. Capacity of any size strainer varies according to viscosity of the liquid being handled. To a marked degree, the strainer is self-cleaning because the heavy particles of foreign matter removed from the liquid settle to the bottom of the cylinder, allowing the vertical sides of the wire mesh basket to remain free for continued work. Additional information is available from the company, 410-412 N. Hermitage Ave., Chicago, Ill.

Leather Oil Seal

A new leather oil seal said to provide extremely low torque, cool operation, no measurable leakage and exceptional life even at 200 F is now being offered by National Motor Bearing Co., Redwood City, Calif.

The seal is called National Micro-Torc. It consists of a chrome-retanned leather sealing lip coated with a dry lubricant and elastomer material which is said to render walls of the sealing lip impervious to lubricants. The center portion of the sealing member retains the natural porosity of leather, thus permitting the sealing member to absorb and store lubricant for use when the normal supply is exhausted, the manufacturer states.

The zero-leakage performance of the seals was demonstrated in numerous 1000-hr tests which showed that no Micro-Torc seals tested leaked as much as 0.5 grams per day, and 90 per cent of seals tested had no measurable leakage whatsoever despite 1000 hr of operation at temperatures reaching 200 F, the company says.

Micro-Torc sealing members are now being made available on all models of National Oil Seals where requested. A technical bulletin "National Micro-Torc Oil Seals" may be obtained from the company.

Produces Titanium Fasteners

Camcar Screw & Mfg. Corp., 629 Eighteenth Ave., Rockford, Ill., announces it is now ready to supply standard and special titanium fasteners in production quantities. The company claims it is now producing parts from RC 130B titanium and is in a position to supply large quantities of fasteners for aircraft, marine and chemical applications.

Titanium alloy RC 130B is a special wire composed of 92 per cent titanium, 4 per cent aluminum and 4 per cent manganese. Camcar says it can produce parts from this material with tensile strengths of 150,000 psi minimum, and shear strengths of 95,000 psi minimum. The metal can withstand temperatures up to 800 F. The alloy weighs approximately 44 per cent less than alloy steels of corresponding strength.

EXCELLENT DURABILITY • CONSTANT COEFFICIENT OF FRICTION • APPLICABLE OVER A WIDE TEMPERATURE RANGE — EVEN WHERE OIL SOLIDIFIES OR CARBONIZES • OPERATE DRY, OR AT HIGH SPEEDS SUBMERGED IN WATER, GASOLINE OR OTHER LIQUIDS • EXCELLENT FOR CURRENT-CARRYING BEARINGS

GRAPHALLOY **materials are also in wide use for oil-free, self-lubricating piston rings, seal rings, thrust washers, friction discs, pump vanes, etc.**

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For applications requiring low electrical noise, low and constant drop, high current density and minimum wear. Used for SELSYNS, DYNAMOTORS, SYNCHROS, ROTATING STRAIN GAGE pick-ups and many other applications. Brush Holders and Coin Silver Slip Rings also available.

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NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

42 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
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DUAL STAGE, combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
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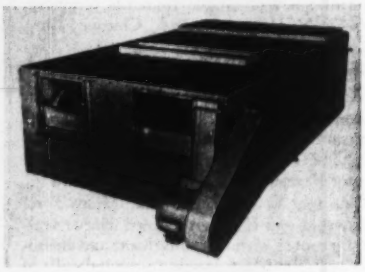
KEEP INFORMED — NEW EQUIPMENT — BUSINESS NOTES — LATEST CATALOGS

Safety Electric Truck

Yale's new safety silhouette electric fork truck is described in detail and the outstanding features illustrated in a new four-page, two-color booklet, Bulletin 5001 available from the Yale Materials Handling Div., The Yale & Towne Mfg. Co., Philadelphia, Pa.

The Bulletin presents the outstanding features of the model and illustrates design points of particular importance. Among these are included accessibility of the driver's seat from either side, low seat position to keep the driver's head below the 68-in. overall height at all times, and low cowl for exceptional visibility. Also listed is a table of dimensions and complete specifications.



Heating-Ventilating Units

A new line of Herman Nelson heating-ventilating units, designed especially for installation in theaters, hospitals, offices, stores, showrooms and for industrial applications, has been announced by American Air Filter Co., Inc., Louisville, Ky.

The new units, with capacities ranging from 1200 cfm to 15,000 cfm, can provide heating, ventilation, filtering, humidifying, or any combination of these functions, it is claimed. Models are available for installation on floors, ceilings, or walls.

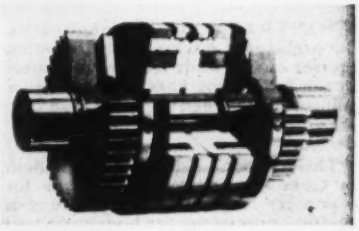
The units are designed for extreme flexibility in performance and installation. They are available with any of ten different heating coils, non-freeze and standard steam, and hot water coils.

Sectional design of the units, with the completely rotatable fan sections, permit the selection of just the components required for a specific job. Sections offered include the heating coil section, 1-2 or -3 centrifugal fan section and humidifier.

Push Button Switches

General Control Co., 1200 Soldiers Field Rd., Boston 34, Mass., has redesigned its line of push button switches.

The switch consists of a new, extruded, frame on which are mounted push button units of from two to a maximum of 12 positions. They can be supplied in the following types: accumulative lock; no two interlock; lock release; and non-lock. Parts are manufactured to meet government specifications.



Electromagnetic Clutch

I-T-E Circuit Breaker Co., Philadelphia, Pa., announces a new design in electromagnetic clutches is now available. Its new electro clutch, according to the company, fits the requirements of transmission employing constant mesh gearing.

The clutch design provides constant horsepower output, quiet operation, and rapid speed change. The company states that safe positive operation is assured because the clutch is controlled by a 24 volt d-c circuit and no field adjustment of the torque value of the clutch can be made.

Maintenance is said to be reduced to a minimum since the electro clutch is self compensating and no adjustment for wear of the clutch plates is required. The company states it anticipates a wide use in the machine tool industry as well as for automatic transmission requirements.

Rectifier-Type Welder

A new 300-amp, NEMA-rated rectifier-type welder claimed to feature quiet operation and low maintenance cost has been announced by the General Electric's welding department.

Now in production at the department's new plant at York, Pa., the welder offers as optional equipment a full time arc force control for holding very short arcs with deep penetration, according to company engineers.

A current range of 20 to 375 amps is provided. The new welder utilizes the moving primary coil design, obtaining current adjustments by separation of primary and secondary coils. Stepless current control and highly accurate amperage settings are made possible by this design. Windings are aluminum and silicone insulation is used on all coils.

Cooling for coils and rectifier stacks is provided by forced-draft ventilating fans. Operating on the updraft principle the fan can be reversed by spring loaded toggle switch to blow dust from the stacks, prolonging their life.

A polarity reversing switch is standard equipment and access for maintenance is simplified due to the unit's removable side covers. Designated 6WR30B, the new welder is available for 220/440 or 550 volts operation. Descriptive publication GEC-1267, can be obtained from the company, Schenectady 5, N.Y.

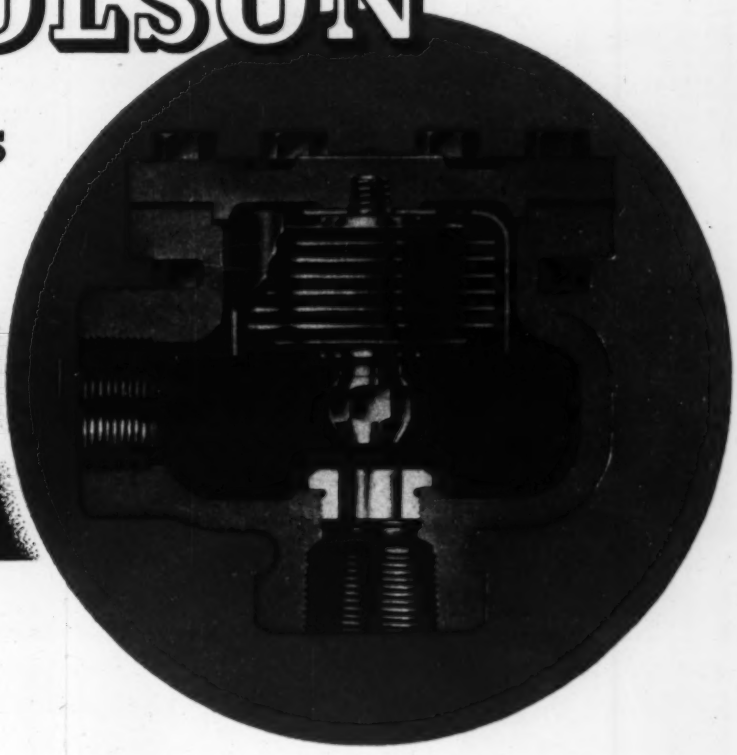
Continued on Page 56

NICHOLSON

Steam Traps feature

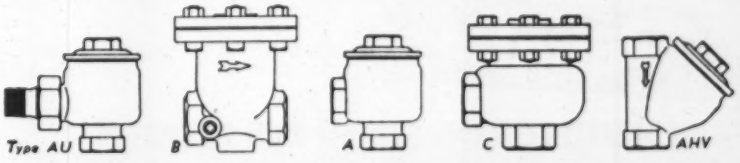
LESS parts

MORE capacity



Note the extreme simplicity of Nicholson industrial steam traps. The heavy-duty bellows integral with valve is the only moving part — a substantial factor in their low maintenance cost. See also the larger valve orifice. This noteworthy feature results in Nicholson's 2 to 6 times average drainage capacity.

A recent survey showed the features following also to be reasons why plants with standardization-for-economy programs are increasingly adopting Nicholson traps: (1) Operate at lower temperature differential; fast action keeps equipment full of live steam; higher temperatures. (2) No air-binding; eliminate costly fluctuation of operating temperatures. (3) Freeze-proof; freely installed outdoors. (4) No need to change valves for varying operating pressures. (5) Record for low steam waste; as little as 1%.



FIVE TYPES FOR EVERY PROCESS, HEAT, POWER USE

Bronze, semi-steel or cast steel construction. All 5 types have stainless steel valves and seats; bronze, monel or stainless steel bellows. Sizes, ¼" to 2"; pressures from vacuum to 250 lbs.

SEND FOR TRAP CATALOG 953

This 32-page standard reference is complete with installation diagrams as well as charts and formulae for determining proper size of trap.

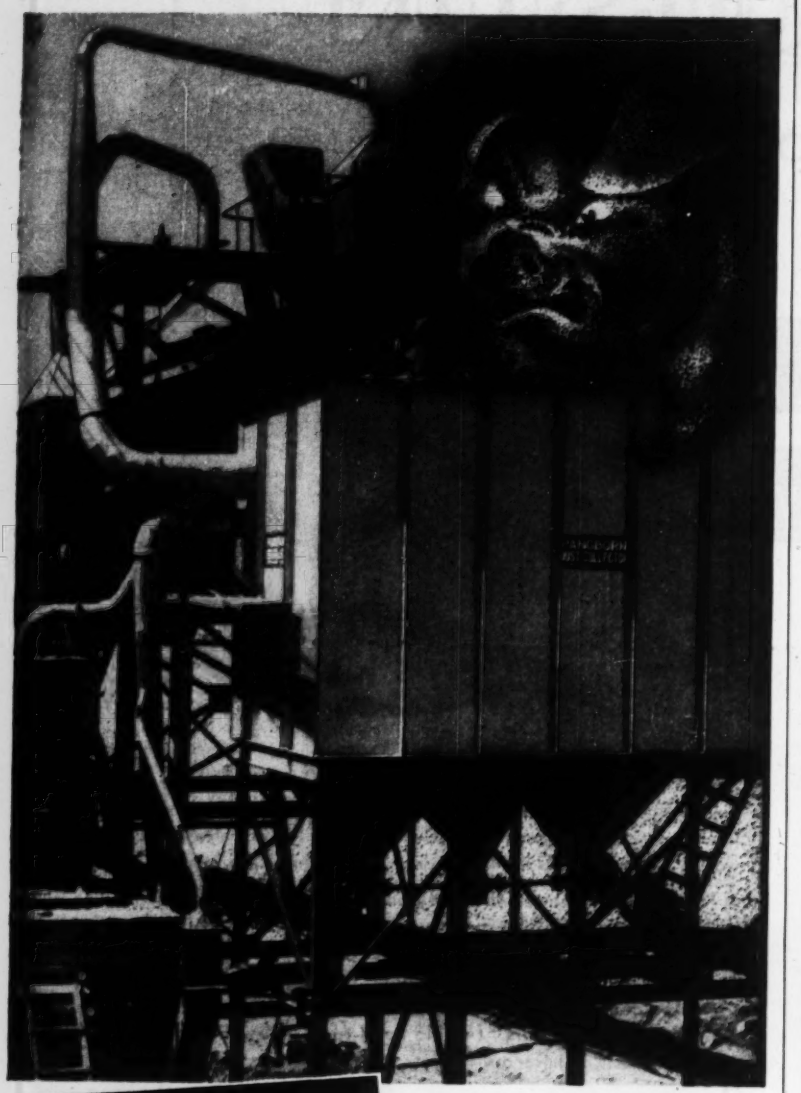
W. H. [redacted] & CO.

TRAPS · VALVES · FLOATS

219 OREGON ST., WILKES-BARRE, PA.

Sales and Engineering Offices in 38 Principal Cities

PANGBORN **STOPS** THE DUST HOG



Pangborn DUST CONTROL

improves product quality

for the H. E. Fletcher Co., West Chelmsford, Mass.—by making possible the marketing of cleaner granite products. In addition, Pangborn Dust Collectors guard employees' health from dangerous dust, protect costly machinery, and permit the salvage of valuable material for resale.

What can Pangborn do for you?

50th Anniversary Medallion

Pangborn engineers will be glad to discuss *your* dust control needs—show you how Pangborn equipment can save you time, trouble, and money. For more information, send for Bulletin 909-A today! Write to: PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Maryland.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Dual Control Crane

Star Machine and Tool Co., 201 S. E. Sixth St., Minneapolis, Minn. is producing a dual-control hydro-lift combination crane, which operates either manually or electrically. The crane is equipped with an electrical unit and power unit to raise any load up to 4000 lb. Power for the attachment is supplied by a standard 6-v automotive battery. In addition, a manual hydraulic control allows operation by hand if desired.

New Flotation Unit

Graver Water Conditioning Co., 216 W. 14th St., New York 11, N. Y. announces a new flotation unit, known as the Aeroflotor, designed for applications in the petroleum, chemical, metallurgical and pulp and paper fields.

Besides handling floatable particles, the unit is capable, when necessary, of also removing settleable particles at the same time in the same unit, the company claims. Since both types of particles are removed continuously, the unit can be used where both heavy and light density are to be removed from the same liquid.

Company engineers' explanation of the unit's operation follows: The influent is aerated under pressure in the air saturator tank to dissolve air in the stream before entering the flotation machine. Upon pressure release, the dissolved air will come out of the solution in the form of tiny bubbles. After entering the flotation machine, the particles physically adhere to the tiny bubbles, increasing their relative density, and rise to the top.

After floating to the surface, the "float" dewaters partly and is moved to a collector trough for removal. The concentration of the "float" can be varied by changing the holding time on the surface before skimming. This is accomplished by adjusting the operating level so as to regulate the quantity being skimmed off by the rotary skimmer.

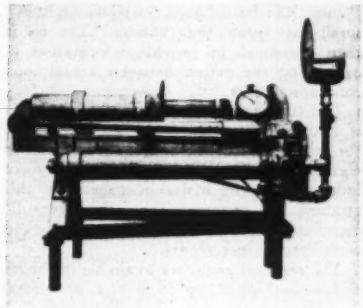
When it is necessary to also remove settleable solids, the unit is equipped with a bottom scraper. Heavy particles settle to the bottom as the water passes downwards through the separator cone and are scraped to a central collector sludge pit from where they are removed for either further use or are discarded.

Large-Bore Clutches

A new series of large-bore clutches for over-running, indexing, and backstopping is announced by the Formsprag Co., 23601 Hoover Rd., Van Dyke. Mich. Applications requiring large-bore sizes up to 12 in., states the manufacturer, can now have the performance features of the sprag principle. The new clutches provide maximum torque capacity for size and weight and instantaneous engagement without head shaft wind-up. They will be constructed with ball bearings for smooth, easy over-running. Further information and engineering-dimension data, can be obtained from the company.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Pressure Controls

Mercoid Corp., 4201 Belmont, Chicago 41, Ill., has announced a series of weather resistant pressure controls designed for application in such industries as chemical plants, petroleum, textiles, bakeries, bottling works, food processors, dairies, mining, printing trades, utilities.

The controls, which conform with NEMA specifications are claimed to be waterproof, splashproof, sleetproof and moisture resistant. They are not submersible.

The series, DAW, is available in 17 operating ranges from 30-in. vac. to 300–2500 psi with sensitivities from 2 oz to 20 psi, dependent on range selected. They are equipped with the company's sealed mercury contacts and are available to open or close an electrical circuit on a rise of pressure. Multiple circuit arrangements can be furnished to meet various needs, the company says.

Pressure Gages

W. C. Dillon & Co., Inc., 14620 Keswick St., Van Nuys, Calif., has devised a portable tester designed to determine the amount of pack in typical cans where oil is employed as a filler. The company says the equipment will be used to attempt to determine standardized pack.

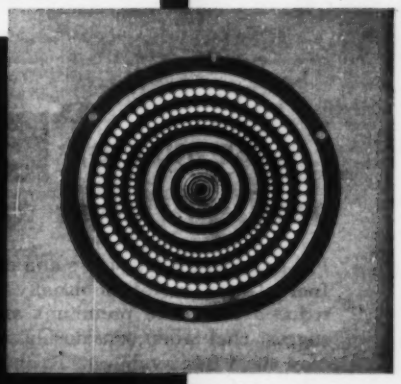
In tests, a sealed can of tuna or other fish is opened and the contents placed into a metal cylinder. A hydraulic ram is brought up against this charge in the cylinder and load is applied. As the material is compressed to a prescribed degree indicated by

MYCALEX

Announces...

Substantial Price Reductions

on Mycalex 410 Telemetering Commutator Plates



Increased production of Mycalex 410 Telemetering Commutators now brings new savings to the user. Universally accepted as the finest commutator plate in the field, this precision-built unit injection-molded of Mycalex 410 glass bonded mica insulation assures permanent dimensional stability ... provides a tenacious bond to the metal inserts.

Important MYCALEX features—

- no dimensional change with age, humidity or temperature
- contact flatness within .0002"
- permanently high inter-contact dielectric strength
- repeated solderability ... no loose contacts under vibration or shock
- high-speed brush means no "bounce", no "hash", provides square wave switching

Revised price lists are available now. Write for your copy today.

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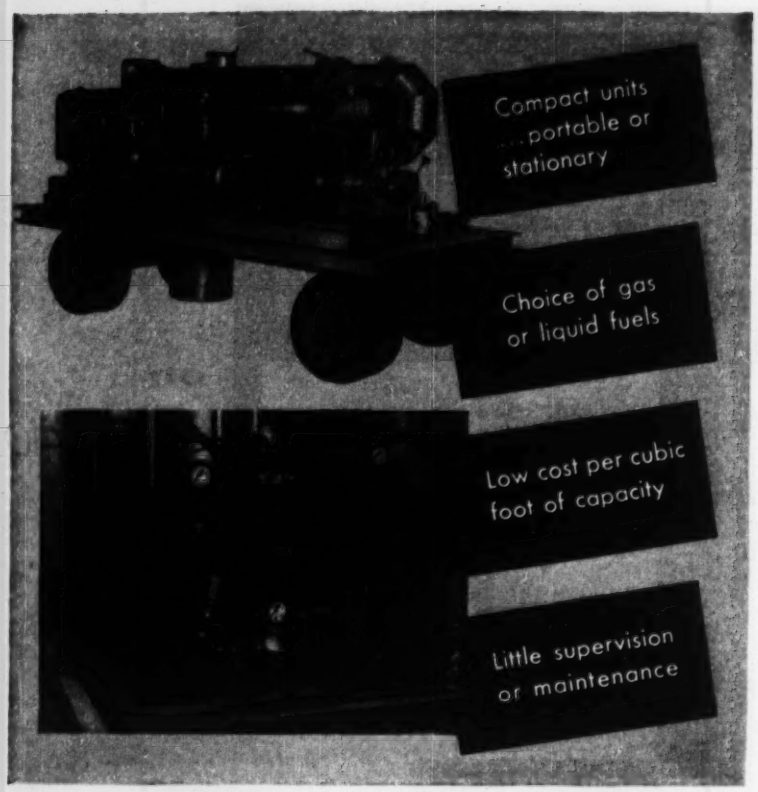
Dept. 126
Clifton Boulevard
Clifton, N. J.

SINCE 1919 MYCALEX THE INSULATOR


Compact units ... portable or stationary
Choice of gas or liquid fuels
Low cost per cubic foot of capacity
Little supervision or maintenance

BE SURE OF "BIG 4"

VALUES IN INERT GAS GENERATORS

For protection against fire and explosion hazards, suitable Inert Gas Generators usually pay their own way, in reduced insurance premiums and property damage. We suggest that when considering such equipment, you compare the 4 basic values of Roots-Connersville units.

To many users, the flexibility of R-C equipment offers a foremost advantage. Portable or stationary units, in a wide range of capacities, give the required protection, when and where needed. Ability to operate on either gas or liquid fuels is important in many locations. Because R-C units are so simple in design, they can be kept in constant readiness, with little attention. Yet all these values are obtainable at a very low cost per cubic foot of capacity.

Our engineering facilities are at your command, to help you select R-C Inert Gas Generators that will give you the greatest amount of protection at the lowest cost. Or, ask for Bulletin 100-B-14 for descriptions and details.

CENTENNIAL 1854 1954

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Reg. U.S. Pat. Off.

A DIVISION OF DRESSER INDUSTRIES, INC.
1854 Michigan Ave. • Connersville, Indiana

BLOWER BUILDERS since 1854

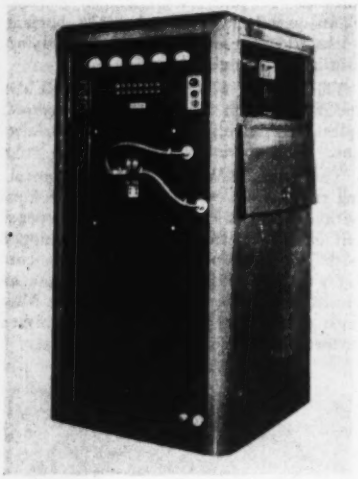
Specialists in handling gas and air

KEEP INFORMED

the unit's hydraulic gage, the oil is caught in a small cup below the cylinder. The oil is then measured to provide information in evaluating the ration between actual food content and filler.

The company's mechanical pressure gage is used to indicate the exact load exerted at the end of the ram and enable the operator to correlate this reading with the indirect force indicated by the hydraulic gage. By this method, the company says, the hydraulic gage may also be calibrated and itself marked with direct lb increments.

The pressure gages are available in ranges as low as 0–10 lb, up to as high as 0–5000 lb. Highest capacity measures $4^3/_4 \times 2^1/_8 \times 3^1/_8$ in. and weighs $2^1/_2$ lb. Maximum pointers and shockless movements are optional. Tensile versions are available from the company on request.



Control, Heating Station

A new motor generator control and heating station incorporating many new features has been designed by Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, Ill., for forging, hardening, brazing or annealing operations where deep penetration of heating is desired. Motor generator sets with frequency cycles of 960, 3000 or 9600 and power inputs ranging from 50 kw to 1250 kw for use with the new station are available for the first time from the company.

The station has been designed to enable metering to be located on either the front, right, or left side. Engineers say the meters can thusly be placed where the operator can easily see them regardless of where it is necessary to place accessory equipment.

The output transformer can be installed or removed through either the front or rear of the station. The output transformer busses can be either vertically or horizontally oriented to accommodate different types of work coils.

A supervisory system of "Checklites" maintains a constant check on air temperature, water temperature, high voltage inter-

locks, water flow, and other operating conditions of both motor generator and work stations. The lights instantly reveal abnormal conditions at any of the many protective devices.

Operations may be timed automatically by means of a four-circuit synchronous timer capable of controlling three operations in addition to the heat cycle. Vernier adjustments are furnished on the first three positions for accurate heat, quench, and capacitor contactor, and 30- or 120-second scales are available if specified.

Optional equipment includes a water cooled variable ratio output transformer of 300 kw capacity permitting efficient loading into a wide variety of work and work coils with a wide safety factor. A maintenance free magnetic amplifier requiring neither tubes or rotating equipment is offered as optional equipment for supplying regulated voltage to the motor generator field for control of power output.

The station is housed in a durable steel cabinet measuring 39 × 39 × 76 in. and weighs approximately 2000 lb. A complete line of auxiliary equipment including work tables, work sinks, work handling mechanisms, is available in different combinations to meet requirements of a wide variety of applications.

Angular Measuring Chart

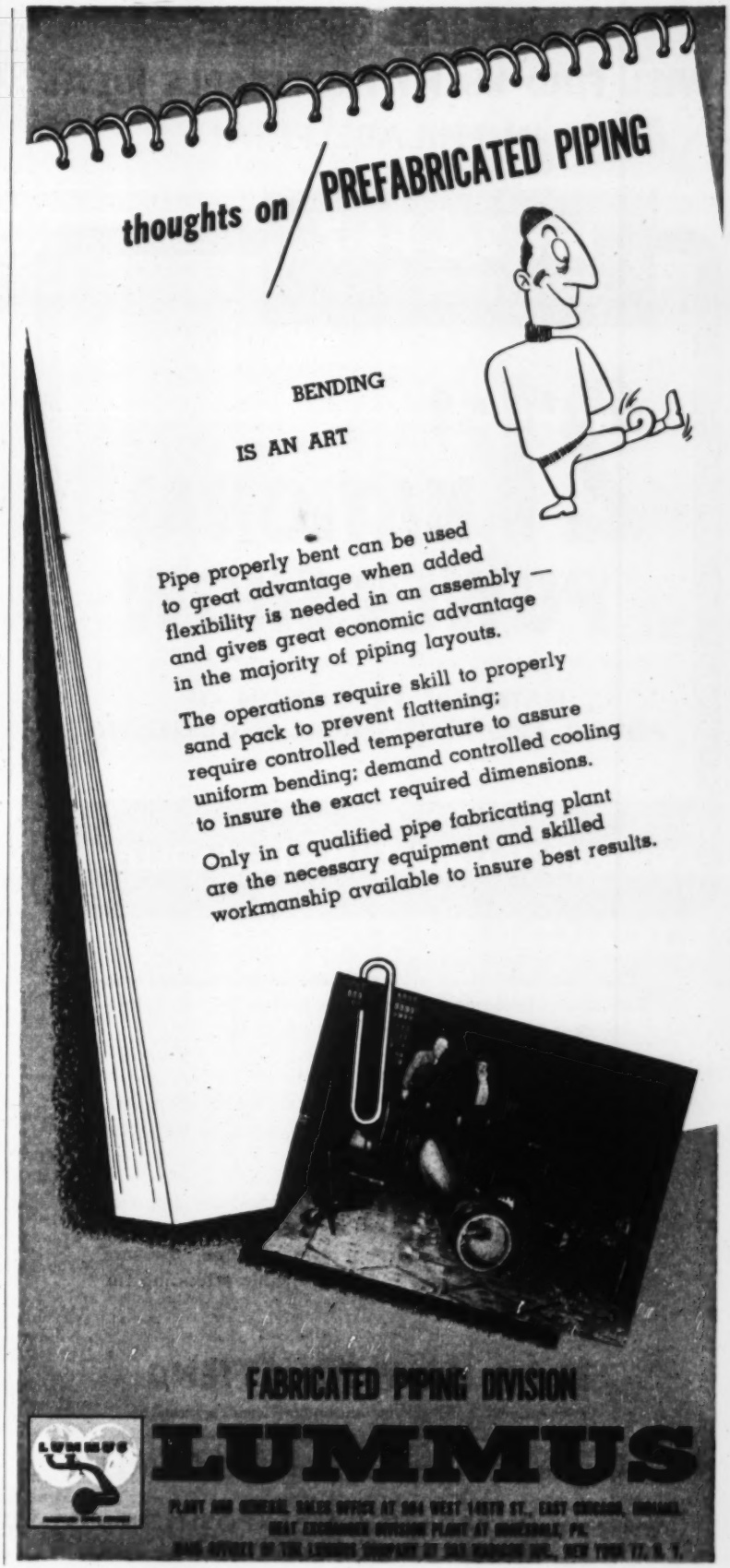
George Scherr Optical Tools Inc., 200 Lafayette St., New York 12, N. Y., announces the development of a new angular measuring chart for use on optical comparators. The chart is said to permit rapid and accurate measurements of all angles for the full 360 degrees with a vernier reading to 5 min. of arc. It is adaptable to all types of projectors not equipped with protractor screens or rotary tables.

Also available on unbreakable plastic are a great variety of standard projector charts, such as screw threads, radii, and grid charts. A service is maintained by the company for furnishing special charts and fixtures to suit individual requirements. Literature on its line of gage precision plastic charts is available from the company.

Trimmer Potentiometers

The Technology Instrument Corp. of Acton, Mass., announces type RFT Metlfilm trimmer potentiometers which embody a unique deposited metal resistance element. This tough, smooth film exhibits excellent characteristics of noise and wear. The sliding contact rides on an adjusting screw. A 90-deg turn of the drive screw results in an approximate voltage change of 1 per cent of the applied voltage. This feature, in conjunction with the infinite resolution of the resistance element, permits voltage settings to be established and maintained with extreme precision.

With a mounting surface approximately $^3/_8$ in square, Metlfilm potentiometers may be stacked with up to seven per square in. of panel area.


thoughts on PREFABRICATED PIPING
BENDING
IS AN ART
Pipe properly bent can be used to great advantage when added flexibility is needed in an assembly — and gives great economic advantage in the majority of piping layouts.
The operations require skill to properly sand pack to prevent flattening; require controlled temperature to assure uniform bending; demand controlled cooling to insure the exact required dimensions.
Only in a qualified pipe fabricating plant are the necessary equipment and skilled workmanship available to insure best results.
FABRICATED PIPING DIVISION
LUMMUS

MEMBERS OF ASME
WILL FIND MANY PROFITABLE IDEAS
IN PHILADELPHIA!

Dec. 2-3-4-6-7
1954

21st NATIONAL POWER SHOW

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Five fact-filled days at the Power Show can save you months of tiresome and expensive research by providing the ideas for your improved plant operation.

Visit the technically staffed booths of the country's leading manufacturers of mechanical, steam, electrical, hydraulic and pneumatic power equipment for the latest word in power technology.

You will learn how to increase production, improve product design and reduce maintenance costs at a minimum expenditure of your valuable time. Be sure to plan a stop-over at Philadelphia while attending the ASME meetings.

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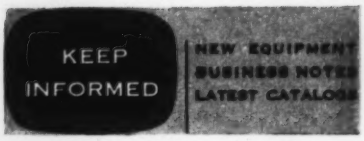
Management: INTERNATIONAL EXPOSITION CO.

480 Lexington Avenue, New York 17, N. Y.



Impulse-Duration Telemeter

A new impulse-duration telemetering system said to transmit and receive long distance measurements of process flow, pressure, liquid level, temperature and other variables has been introduced by The Foxboro Co. Foxboro, Mass.

Designed for reliable transmission of measurement in applications such as reservoir level, natural gas line flow and pressure, and intra-plant control systems, the system, called Teletax Telemeter, can handle distances up to 150 miles by wire or may be operated over radio link or microwave channels, the company says.

Because the system operates as a function of pulse duration, the signal level can vary widely without affecting operation or accuracy. At 12-second intervals the telemeter transmitter sends a pulse to the receiver proportional in duration to the variable being measured. The receiver automatically compares the duration of this pulse to that of the previous one and actuates a reversible motor which positions a recorder pen or indicator pointer to reflect any measurement change.

New Retaining Ring

A new radially-applied retaining ring which, the company claims, can be locked positively in its groove and used as a shoulder against rotating parts, replacing expensive nuts and bolts and eliminating the need for springs, washers, and other accessory fastening devices, has been introduced by Waldes Kohinoor, Inc., Long Island City, N. Y.

Called the Waldes Truarc series 5139 retaining ring, the fastener is intended for use in the automotive, electronic and aeronautical industries and for a wide variety of other applications in which an easily assembled, positive-locking fastener is required.

The new ring is made of spring steel and is shaped like a bowed horseshoe. When fastened to a shaft it is locked in its groove by two prongs extending from the inner circumference of the open end. It is manufactured in sizes to accommodate shafts ranging in diameter from $^1/_8$ to $^1/_2$ in., with larger sizes available for special applications.

Electronic Packages

A method of arranging the various electronic circuits in separate units into "electronic packages" called Sealpak has been devised by Reliance Electric and Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, Ohio.

Company engineers explain these electronic packages function as the "building-blocks" of which the control as a whole is constructed. Each contains its own electronic circuit for its own particular purpose. The packages are mounted on the panel, each separate and independent from the other. The units are pre-tested, contain high-reliability amplifier tubes, and are inter-connected by attaching leads to screw-type terminals.

Components are sealed in plastic, and encased in a metal enclosure to provide protection against dirt, corrosive atmospheres,

AIRCRAFT ENGINEERS

With Experience

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GRUMMAN

LAYOUT DESIGNERS
Airframe Structures
Equipment Installations

FLIGHT TESTING
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TOOL ENGINEERS

Recent Graduates with Aeronautical, Mechanical, Civil or Engineering Physics Degrees may qualify

Proof of U. S. Citizenship required

APPLY IN PERSON
OR SEND RÉSUMÉ TO:
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GRUMMAN AIRCRAFT
Engineering Corp.
Bethpage, N. Y.

vibration, and shock, which lessen chance of failure. Advantage of this new method is simplified maintenance. Engineers say when trouble occurs, it is only necessary to test a relatively few connections according to a pre-determined test procedure. The Sealpak in which trouble lies can be disconnected, removed, and a new Sealpak installed in its place. In case of emergency need, the Sealpaks will operate on radio-television tubes, until replacement amplifier tubes can be obtained.

New England Office

The Detrex Corp. of Detroit, manufacturer of chemicals and industrial metal-cleaning equipment, has established a New England regional office in Meriden, Conn.,

Headed by A. D. Chabot, New England region manager, the new office will serve Vermont, Maine, New Hampshire, Massachusetts, Connecticut and Rhode Island. It is located at 35 Colony St. in Meriden.

Southern Distributors

Appointment of Florida Metals, Inc. as authorized distributor for hydraulic Hoze-lok fittings and hose assemblies is announced by Parker Appliance Co., Cleveland, Ohio. Florida Metals maintains warehouses at 222 N. 12th St., Tampa; 2937 Strickland St., Jacksonville; and 3690 N. W. 52nd St., Hialeah, Miami.

The new distributor will maintain stocks of Hoze-lok fittings at all three points in addition to established stocks of tube fittings for prompt servicing of customer needs.

Also, the company announced appointment of Flow Engineering Sales Co., 405 Woodland Dr., Birmingham 9, Ala., as authorized distributor for Parker tube fittings and related products.

This new distributor will maintain stocks of Parker fittings including Triple-lok, Ferulok, In-tru, and Weld-lok types as well as tube fabricating tools, for prompt servicing of customer needs in the Alabama area.

Moves Office

The Trane Co., manufacturer of air conditioning, heating, ventilating, and heat transfer equipment announces that its sales office in Greenville, S. C. has been moved to the Shives Bldg., 644 E. Stone Ave.

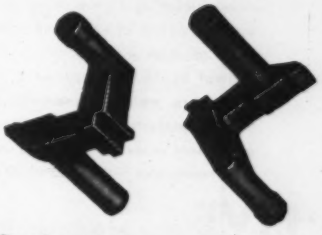
Distributor Named

Dietz Industrial Supply Co., Aurora, Ill., has been named an authorized distributor for Carboloy Dept. of General Electric Co., Detroit. The organization will carry the department's entire line of standard cemented carbide tools and blanks, carbide-tipped masonry drills and diamond wheel dressers.

Forgings Replaced

WITH Ep Co

INVESTMENT CASTINGS



Castings pass 100% X-ray inspection.
Material: Alloy Steel AISI 8620

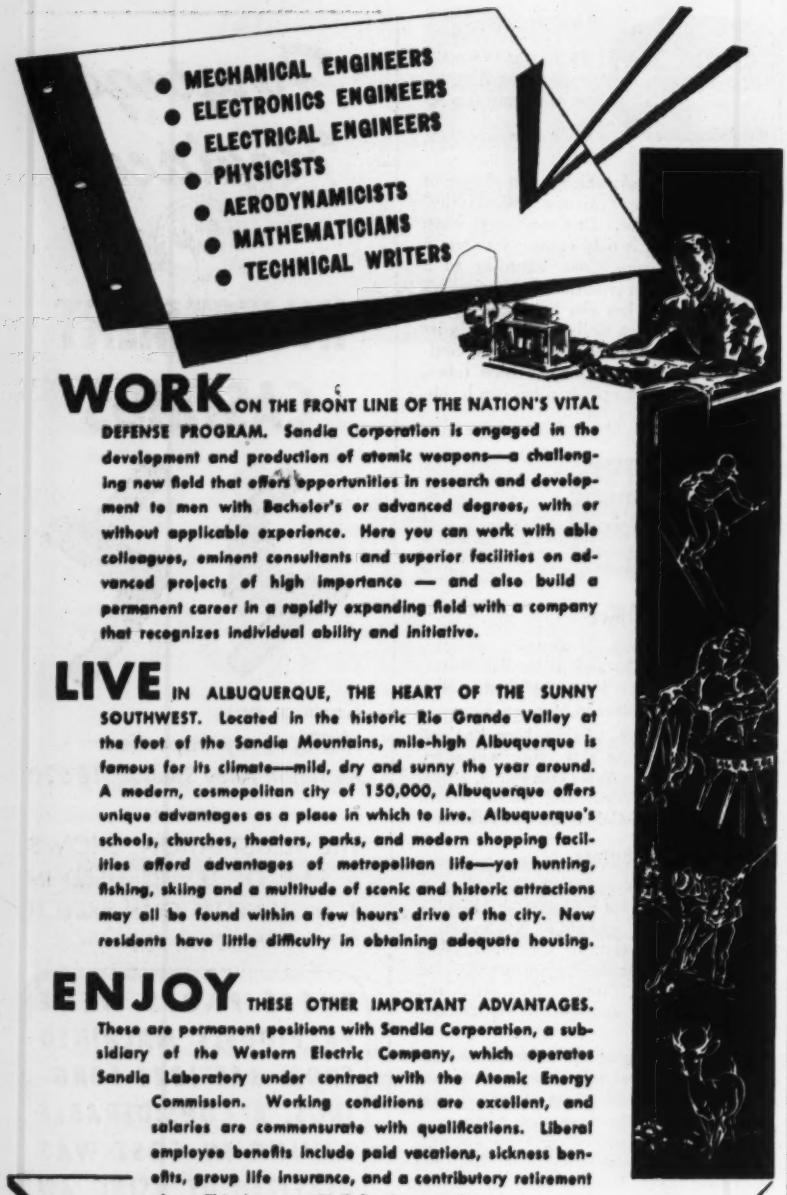
THE ILLUSTRATION SHOWS A PAIR OF LEVERS USED IN A HIGH-SPEED GUN BREECH MECHANISM

THESE PARTS WERE PREVIOUSLY MACHINED FROM SAE 1020 FORGINGS. A CONSIDERABLE SAVING IN COST WAS REALIZED BY USING AN EPCO INVESTMENT CASTING

SEND US YOUR DRAWINGS FOR QUOTATION ON PARTS WHERE ***EXTRA QUALITY*** MUST BE MAINTAINED

Ep Co
ENGINEERED
PRECISION CASTING CO

N. J. HWY. 79
MATAWAN, N. J.



WORK ON THE FRONT LINE OF THE NATION'S VITAL DEFENSE PROGRAM. Sandia Corporation is engaged in the development and production of atomic weapons—a challenging new field that offers opportunities in research and development to men with Bachelor's or advanced degrees, with or without applicable experience. Here you can work with able colleagues, eminent consultants and superior facilities on advanced projects of high importance — and also build a permanent career in a rapidly expanding field with a company that recognizes individual ability and initiative.

LIVE IN ALBUQUERQUE, THE HEART OF THE SUNNY SOUTHWEST. Located in the historic Rio Grande Valley at the foot of the Sandia Mountains, mile-high Albuquerque is famous for its climate—mild, dry and sunny the year around. A modern, cosmopolitan city of 150,000, Albuquerque offers unique advantages as a place in which to live. Albuquerque's schools, churches, theaters, parks, and modern shopping facilities afford advantages of metropolitan life—yet hunting, fishing, skiing and a multitude of scenic and historic attractions may all be found within a few hours' drive of the city. New residents have little difficulty in obtaining adequate housing.

ENJOY THESE OTHER IMPORTANT ADVANTAGES. These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates Sandia Laboratory under contract with the Atomic Energy Commission. Working conditions are excellent, and salaries are commensurate with qualifications. Liberal employee benefits include paid vacations, sickness benefits, group life insurance, and a contributory retirement plan. This is not a Civil Service appointment.

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PROFESSIONAL EMPLOYMENT
DIVISION B

SANDIA *Corporation*

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Dravo Distributor Appointed

D. M. Robinson Co., 2436 S. Blvd., Houston 6, Tex., has been appointed exclusive distributor of Dravo heaters and industrial air conditioners for the following counties in Texas: Angelina, Austin, Bastrop, Brazoria, Brazos, Burleson, Calhoun, Chambers, Colorado, Fayette, Fort Bend, Galveston, Grimes, Hardin, Harris, Houston, Jackson, Jasper, Jefferson, Lavaca, Lee, Leon, Liberty, Madison, Matagorda, Milam, Montgomery, Newton, Orange, Polk, Robertson, San Jacinto, Trinity, Tyler, Victoria, Walker, Waller, Washington and Wharton; and the parishes of Allen, Beauregard, Calcasieu, Cameron and Jefferson Davis in Louisiana.

Relocates Office

Lord Mfg., Co., Erie, Pa., has announced the relocation of its New York regional field engineering office to 630 Fifth Ave., Rockefeller Center, New York 20, N. Y. The company says the expansion was done to provide better engineering service to prospects and customers in the eastern area.

Taft-Peirce Elects Director

On September 8, 1954 at a meeting of the Board of Directors of Taft-Peirce Manufacturing Co., Woonsocket, Rhode Island, manufacturers of machinery and tools, F. Steele Blackall, III, was elected Vice-President of the company. Mr. Blackall is a member of the Executive Committee of the Providence section of the ASME. He is a graduate of Yale University in Mechanical Engineering, Class of 45W and the Harvard Graduate School of Business Administration. Mr. Blackall is also Assistant Treasurer, Assistant General Manager and a Director of the company.

Acquires Chicago Pump

Food Machinery and Chemical Corp. has announced its purchase of Chicago Pump Co., a producer of patented sewage treatment and disposal equipment and specialty pumps for building services.

Chicago Pump Co. was acquired to complement FMC's regular lines of Peerless industrial and agricultural pumps with a line of specialized equipment in the waste disposal and building fields. As a subsidiary of FMC, Chicago Pump Co. will be an operational component of the parent corporation's Peerless Pump Div.

Larger Quarters

Otto H. York Co., Inc., manufacturer of technical wire mesh products and York Process Equipment Corp., manufacturer of liquid-liquid extraction columns, line separators, and custom engineered process vessels, announce the relocation of their offices and plants to new, larger quarters at 6 Central Ave., West Orange, N. J.

The move represents a four-fold expansion in office and plant space and an enlargement of manufacturing, testing, laboratory, and storage facilities.

KEEP INFORMED

Eastern Sales Office

A new combined sales office has been opened by the New York Air Brake Co. at 90 West St., New York, N. Y., to give its eastern customers the benefit of the centralized facilities of its divisions, Kinney Mfg. Co., Dudco Div., Hydreco Div., Aurora Pump Co., and Watertown Div.

The new office is intended to give the individual divisions common offices, coordinated sales facilities and warehouse space which will give eastern customers faster delivery of products from all divisions. The warehouse will carry a complete line of all standard hydraulic and vacuum pumps made by NYAB.

LATEST CATALOGS

Services Bulletin

Condenser Service & Engineering Co., Inc., Hoboken, N. J., has issued a four-page folder outlining its services in the fields of re-tubing, rebuilding, repairing, re-designing and metal spraying.

Included in the folder are illustrations of manufactured products, such as heat exchangers, filters, condensers, pressure vessels, continuous centrifuges and specialties as well as the company's maintenance services with steam engines, instruments, re-tubing and metal spraying. The company also outlines its field and plant facilities and lists a case history on 133 miles of tubing.

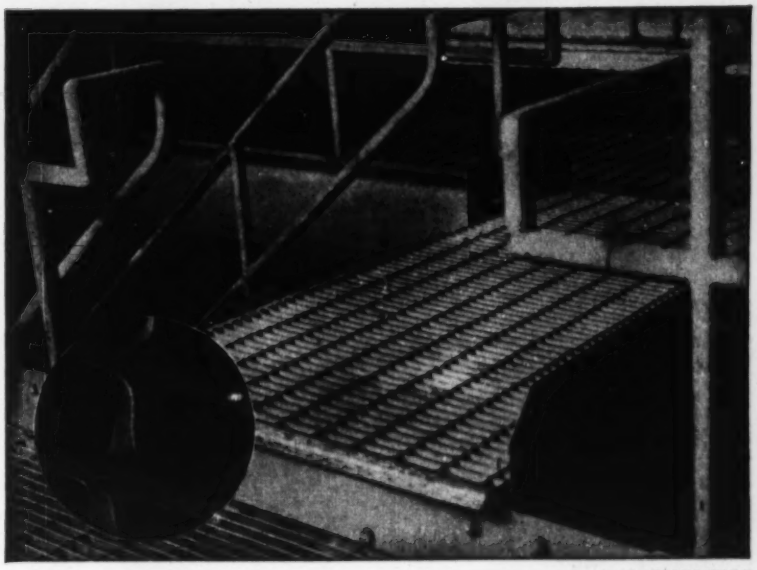
New Line of Small Boilers

A new bulletin, AD-135, describing the recently announced CB50-80 line of small boilers has been issued by the Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee 12, Wis. The bulletin, AD-135, describes the New CB boilers and contains information of such advantages as silent operation, fuel flexibility, fast, easy maintenance, automatic safe operation.

Flange, Coupling Selector

A revised edition of the flange and coupling selector, designed by the Nooter Corp. is now available in easy-to-read slide rule form. It provides all the information contained in the earlier selector plus new data.

The flange size selector lists such facts as the OD of flange, thickness, OD of raised face, no. of holes, diameter of holes, diameter of bolts, bolt circle—for Series 15 and 30 flanges. The coupling selector shows average sizes of standard, extra heavy, 3000 lb and 6000 lb couplings. Also a convenient pipe standard table is incorporated on the selector, showing nominal wall thicknesses for schedules no. 10 to 160 as well as nominal thicknesses and weight per foot for standard, extra heavy and double heavy pipe. The selector may be obtained from the Nooter Corp., 1400 S. Second St., St. Louis 4, Mo.



Grating by BLAW-KNOX

where do **you** need

steel grating?

There must be lots of places where you are now using grating—floors, platforms, walkways, catwalks and stair treads, for example.

But how about other uses—such as some sturdy shelving or a fan guard—or for covering a dangerous open pit or a light well. Take a good look around your plant and you'll probably come up with several jobs, including perhaps a new use, as steel grating is adaptable to many applications.

Any time you want some help on a job related to grating, we'll be glad to hear from you.

Only BLAW-KNOX Electroforged® Steel Grating and Stair Treads —have these five exclusive features:

1. **rigid one-piece construction—easy to install**
2. **all surfaces accessible—easy to paint**
3. **no sharp corners to clog—self-cleaning**
4. **maximum open area—for light and ventilation**
5. **non-slip twisted crossbar—safe footing**

A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

BLAW-KNOX

BLAW-KNOX COMPANY
2105 Farmers Bank Building • Pittsburgh 22, Pennsylvania

BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

You may well be one of a select group of men intently interested in developing tomorrow's jet fighters . . . special reconnaisance aircraft . . . jet bombers and transports. The Aircraft Division of Fairchild offers a genuine creative opportunity to such men.

New concepts of flight for the jet era . . . as well as engineering advances on the world-renowned C-119 Flying Boxcar and soon-to-be-produced C-123 Assault Transport are coming from Fairchild. Diversified, stimulating assignments like these increase the inventive challenge to Fairchild's team of qualified aerodynamicists.

Gracious country living only minutes away from urban Baltimore or Washington . . . paid pension plan . . . an excellent salary with paid vacations . . . ideal working conditions . . . generous health, hospitalization and life insurance . . . and the many other benefits of a progressive company add to the pleasure of working with Fairchild.

You'll be investing wisely in a secure future if you take time today to write to Walter Tydon, Chief Engineer, outlining your qualifications. Your correspondence will be kept in strict confidence, of course.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Aircraft Division
HAGERSTOWN, MARYLAND

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Storage Handling

A new four-page folder is available from Stackbin Corp., 1241 Main St., Pawtucket, R. I., which describes the Stackbin system of storage and materials handling. It shows graphically how the system is used throughout industry to cut handling costs, save space, improve inventory control, minimize loss and damage and gives specifications and prices on stackbins, stackracks and sectional stackbins, the elements of this space, and cost-saving handling system.

Welding Data

Descriptive information along with application and procedure data on all Murex mild steel and low alloy arc welding electrodes are included in a new 30-page catalog now being offered by Metal & Thermit Corp.

Designed to be helpful in selecting exactly the right electrode for the job in hand, the new catalog also contains formulas for estimating welding costs, heat treating procedures, hardness conversion tables, and other reference material for the welding engineer, metallurgist, and welding foreman. Copies are available from the company, 100 E. 42nd St., New York 17, N. Y.

Industrial Pumps

A new Industrial catalog, I-54, containing 108 pages and describing practically every industrial pump now made by the Deming Co., Salem, Ohio, has been announced as available.

Additions to the line include new, large capacity, deep well submersible pumps, Fig. 6710 for wells 4 in. ID and Fig. 6720 for wells 6 in. ID or larger; new, two-bearing end suction centrifugal pumps, Figs. 4001, 4011, and 4021; "Motormount" centrifugal pumps, Figs. 4350 and 4355 for sprinkling and air conditioning applications particularly; and Figs. 1890BF, 1895BF, and 6606BF pumps for boiler feed service.

Contents of the new catalog include information on construction features, performance and selection tables for the complete industrial line of Deming Pumps; and several pages of useful information related to liquid materials handling problems.

Ball Bearing Swivel Fittings

A new, colored descriptive bulletin covering the Emsco HP and HT small size high pressure and high temperature ball bearing swivel fittings is offered the trade free upon request. The bulletin includes small size ball bearing swivel fittings in sizes from $^3/_8$ to 1 in. and from working pressures of 6000 lb psi at 225 F to 1250 lb psi at 750 F.

The new sales bulletin describes the method of construction and application of these fittings as well as giving complete dimensions, specifications, weights, and engineering data. It is illustrated with sectional drawings and shows the various types of packing for steam, hot water, oil, liquefied petroleum gases, chemicals. Copies may be obtained from Emsco Mfg. Co., Box 2098, Terminal Annex, Los Angeles 54, Calif.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Lycoming Story

A 40-page brochure, "The Lycoming Story," featuring highlights of the company's history, products, plants, research, engineering, and services has been announced as available from Lycoming Div., Avco Mfg. Corp., Stamford, Conn.

The booklet outlines the division's activities in the fields of aircraft engines, turbine engineering and research, industrial engines, tank engines, complete assemblies, hardened and ground precision parts, gears and machined parts, generator sets, engine overhaul, engineering and design, new idea development, heat treating and plating, steel fabrication, castings, and heat boilers.

Packing Material

"Chempac Packings & Gaskets" is the title of a new 6-page, illustrated folder issued by Johns-Manville. These materials, which are claimed to be virtually unaffected by corrosive chemicals and active solvents, are made of asbestos treated with Teflon, and are especially designed for chemical and process equipment.

The folder gives pertinent information on each of the several types, including interlocked packings, a braided material offered in two styles; packings in coil, spiral and ring forms which are offered in four styles; general purpose gaskets offered in two styles; folded gaskets for glass lined equipment offered in two styles; and, Spirotallic Flange Gaskets. The folder also carries information on solid Teflon sheets. Copies of the bulletin may be obtained from the company, 22 E. 40th St., New York 16, N. Y.

Grommet Brochure

A new 16-page brochure in handy file folder form, listing sizes and types of grommets available, has just been issued by Goshen Rubber Co., Inc., Goshen, Ind. Copies are obtainable upon request.

The Goshen line includes the complete Air Force-Navy Standard AN931 grommet series, 34 basic sizes, each available with 1/16, 1/8, 3/16, and 1/4 in. groove widths, and the 34 sizes in the web type with 1/16-in. groove width. In addition, there are many special sizes, all of which can be furnished from industrial compounds.

Standardized Drives

Details of how power transmission costs may be cut by using standard Cone-Drive reducers, gearsets and components are available in Bulletin 789-54, titled, "Standardized 7 Ways to Cut Your Power Transmission Costs," available from Cone-Drive Gears Div. of Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

Brief descriptions of standard components including horse power ratings, reductions and pinion speeds handled by units carried in stock are included. A condensed chart gives typical horsepower ratings at 100 and 1750 pinion rpm and weights of units from 2- to 18-in. center distance.

When you're looking for a material that resists

IMPACT

micarta is basic!

MICARTA® simply soaks up impact. Vibration, too. And it muffles noise. Its inherent toughness gives it unusual compressive strength . . . high resistance to moisture and corrosion . . . and to extremes in temperature. But tough as it is, MICARTA can be easily and accurately fabricated. How can this amazing, feather-weight material serve and save for you? Use the coupon for the complete story.

J-06577

YOU CAN BE SURE...IF IT'S Westinghouse

MICARTA's Unique Properties are serving every industry in applications ranging from tiny punched parts to massive steel mill bearings.

Westinghouse Electric Corporation, Trafford, Pa.
MICARTA Division, Attention: L. A. Pedley

Sirs (Please check one)

☐ Please have your representative call
☐ Please send me complete facts on MICARTA

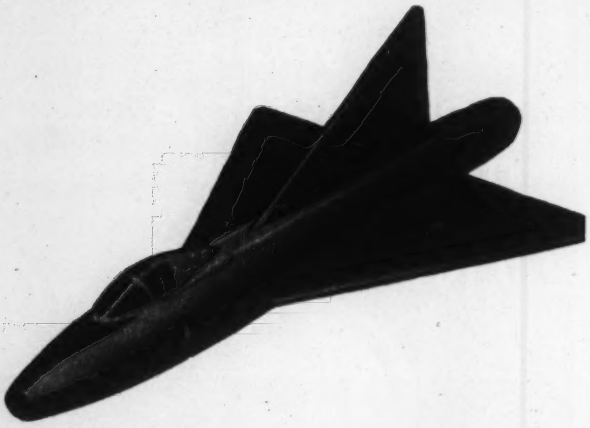
ME-10-54

Name_____

Company_____

Address_____

City_____ Zone_____ State_____



THE CONVAIR CHALLENGE TO ENGINEERS OF EXCEPTIONAL ABILITY

Beyond the obvious fact that Convair in San Diego offers you a way of living judged by most as the nation's finest from the standpoint of weather, beauty and interesting surroundings, the Convair Engineering Department offers you challenges found in few places.

It is, we believe, an "engineers" engineering department—interesting, energetic, explorative — with the diversity that means security for capable personnel.

As proof, consider this: **Convair developed and flew the world's first turbo-prop airplane, first delta-wing airplane, first delta-wing seaplane — engineered and built the world's biggest transport, the world's safest high-performance commercial aircraft.**

Or this: **Convair's B-36 is the world's largest operational bomber, Convair's B-24 Liberator was World War II's most used heavy bomber, Convair's XP5Y-1 holds the world's endurance record for turbo-prop aircraft.**

Or this: **Convair has been awarded the nation's first production missile contract and the first production contract for supersonic interceptors.**

Currently . . . **Convair has the greatest diversity of aircraft engineering projects in the country, including high-performance fighters, heavy bombers, large flying boats, transports, trainers, seaplane fighters and guided missiles.**

Currently . . . **Convair has a completely integrated electronic development section engaged in advanced development and design on missile guidance, avionic projects and radar systems.**

Would you like to join us? **We earnestly need engineers of proven ability — men who want to make full use of their time, their minds, their skills and abilities solving the complex problems confronting us in these projects. If you are such a man, write us and we'll send you a free booklet about us, plus other interesting material to help you make the decision.**

Write: **H. T. BROOKS, Engineering Personnel Department M-9**

CONVAIR

3302 PACIFIC HIWAY

in beautiful San Diego, California

Shims Literature

An eight-page bulletin on Laminum shims, a four-page folder on shims and stampings to rigid specifications, and a data sheet on new Aluminum shims have been announced as available from Laminated Shim Co., Inc., Glenbrook, Conn.

The bulletin, commemorating the company's 40th anniversary contains overall engineering and design data and specifications on brass, steel and aluminum shims, while the other literature outlines specific techniques and data on the use of specialized products of the company.

Hydraulic Winch System

A new four-page, two-color, $8\frac{1}{2} \times 11$ illustrated catalog, A-5225 describing the Vickers hydraulic winch system for airborne applications is now available from Vickers Inc., 1400 Oakman Blvd., Detroit 32, Mich.

Typical hydraulic winch circuits for single-speed and two-speed reel operation are shown in schematic diagrams. A typical control system for helicopter installation is described and illustrated in the catalog. The winch system components described in this catalog are nominally 1000 psi hydraulic accessories.

Also presented in the catalog are fully dimensioned installation drawings giving complete specifications for Vickers winch system accessories. Included are those for the hydraulic motor-driven winch assembly, solenoid-operated four-way valve, automatic two-speed valve, hydraulic reservoir assembly and fixed displacement pump.

Gravity Filters

A 24-page bulletin, Permutit Gravity Filters, No. 2539B, superseding a bulletin issued in 1952 has been prepared by The Permutit Company, 330 West 42nd St., New York 36, N. Y. It shows a complete line of gravity filters and filter accessories, manually operated, semi-automatic and automatic, including operating tables, rate of flow controllers and gages.

Specifications, operating instructions and characteristics, outline dimensions and typical installation photographs have been included in this edition.

New Literature Available

A new two-page catalog sheet, No. 4140-19, illustrates and describes the new Beaumont Birch No. DT-132B "Dura-Tred" "Beaucolloy" steel combination chain, including construction features, operation and application.

Designed for use with "Trac-Pull" wheels, the new combination chain is designed for all types of bucket elevators or conveyors handling bulk materials. A special "Dura-Tred" feature provides 340 per cent more metal on the wearing trend of the link, the company says. The "Beaucolloy" metal has an average ultimate strength of 175,000 psi. The bulletin is available from Beaumont Birch Co., Inc., 1501 Race St., Philadelphia, 2, Pa.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Advanced Pressure Elements

A new line of pressure measuring elements with greater operating power and improved accuracy are described in Bulletin 6-10, "Pressure Recorders," issued by the Foxboro Co., Foxboro, Mass. The 24-page publication explains the company's line of pressure instruments designed for direct measurement, remote transmission and automatic control. An application chart shows the wide choice of element materials available. The bulletin also describes case and linkage features, lists charts for standard process ranges, and covers accessories such as seals and pulsation dampeners.

Valve Controls

Philadelphia Gear Works, announces a new 21-page catalog, L-54, fully describing "Limi-Torque" valve operators which are said to eliminate the need for manual operation of valves.

The new catalog illustrates and describes the latest LimiTorque SMA valve control for large or small valves, as well as showing operational details and illustrations.

It will be sent upon request to Philadelphia Gear Works, Erie Ave. and G St., Philadelphia 34, Pa.

Light Structurals

A 20-page booklet describing the uses of Jones & Laughlin Steel Corp. light structurals, "Junior Beams," has been announced as available from the company, 3 Gateway Center, Pittsburgh 30, Pa.

The booklet contains pictures showing how the light structurals are adapted to floor and roof design in buildings, and to miscellaneous uses like truck and trailer frames, ship building, and grandstand construction. Specifications and design information also are included in the booklet.

Industrial Catalog

Chiksan Co. has issued a new 32-page catalog, G-4, which covers the complete line of Chiksan ball-bearing swivel joints and other products, including loading racks, manifolding lines, all-metal marine and barge hose, and flexible aircraft assemblies.

In addition to providing dimensional and operating data on these products, typical industrial applications for Chiksan equipment are illustrated. Catalog G-4 is available upon request from the company, Brea, Calif.

you give THROUGH THE RED CROSS

BIG PUMPING JOBS

OR LITTLE PUMPING JOBS

IF IT'S ROUGH AND TOUGH IT'S A JOB FOR *Nagle* PUMPS

Nagle Pumps are engineered and constructed with only one thing in mind . . . abusive applications. If you pump materials that eat away or grind away ordinary pumps then you need Nagles. Vertical and horizontal shaft centrifugal pumps in a complete range of sizes and capacities.

A 4" Nagle type "SW-OB" pump is shown at left, built for a large mining operation and a 1½" type "SW-OB" is shown at right made for a porcelain enameling firm. Both have given satisfactory performance many years . . . with many years to go.

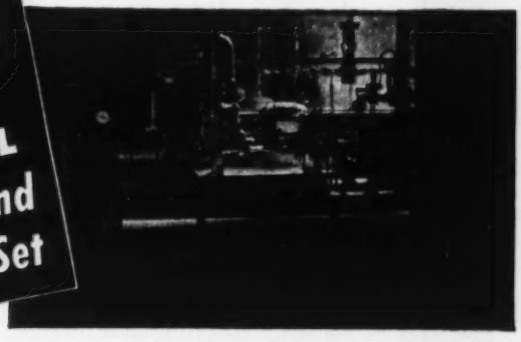
The type "SW-OB" is submerged in material to be pumped. No stuffing box . . . no submerged bearings. Quick slippage seal adjustment. Proper materials of construction. Send for Catalog 5206.

NAGLE PUMPS

NAGLE PUMPS, INC.
1299 CENTER AVENUE, CHICAGO HEIGHTS, ILLINOIS

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

ENCO DUAL FUEL-OIL Heating and Pumping Set



Two heaters and two pumps—one steam, one electric driven—in one set with these six features:

1. Completely automatic operation with temperature and pressure regulation.
2. All essential equipment—including safety valves as needed—in one compact unit.
3. Individually designed to meet the specific needs of the power plant.
4. All parts visible and accessible for easy operation, maintenance and repair.
5. Pumps run at moderate speed. Heaters designed to give the correct viscosity and velocity without fouling.
6. Cleaner boiler room . . . all overflows connected to a common outlet, flanged drip pan for pumps catches oil drip.

EC490

THE ENGINEER COMPANY
75 WEST STREET, NEW YORK 6, N. Y.
IN CANADA: ROCK UTILITIES LTD., 80 JEAN TALON ST. W., MONTREAL, P. Q.

career opportunities in

Nuclear AIRCRAFT Propulsion

for Engineers • Physicists • Chemists • Metallurgists

Here's a genuine opportunity if you are an engineer or scientist who wants to build a sound, well-rewarded career in private industry.

We are engaged in a development program on a reactor-powered aircraft engine. Because of this, we have an immediate need for engineers and scientists with training or experience in nuclear engineering or related fields—Thermodynamics, Heat Transfer, Controls, Reactor Physics, Theoretical Physics, Physical Chemistry, Stress and Vibration, High-Temperature Metallurgy.

If you can qualify, we can offer you an opportunity to work for us on one of today's most challenging assignments—a chance to be in on the early development of a great and revolutionary advance in aircraft propulsion.

At Pratt & Whitney Aircraft you'll be working for the world's foremost designer and builder of aircraft engines, on a project that will give you a *real* chance for professional growth and recognition.

Please send us immediately a complete resume covering your training and experience. Write Mr. Paul Smith, Employment Office.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

East Hartford 8, Connecticut

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Lubrication Filters

Trabon Engineering Corp., 1814 E. 40th St., Cleveland, Ohio, has published a two-page bulletin, No. 545, on its series "SH" and "DH" high pressure lubrication filters. These light, sturdy filters are constructed of high tensile cast aluminum with steel sump and tie rod and are built to withstand 1000 psi working pressure and 1800 psi test pressure. The bulletin includes dimensional material, illustrations, diagrams, and comprehensive data charts.

Ball Bearing Catalog

Split Ballbearing Corp., Lebanon, N. H., has issued Catalog No. 54, 20 pages, showing a complete line of split ball bearings.

The catalog gives load and speed ratings, design data, dimensions, and shows single and double row ball bearing bushings in extra-thin section; fully split, heavy duty pillow blocks; fully split, heavy duty ball and roller bearings; thin section instrument bearings in torque tube dimensions for precision applications. Information on the various design features possible by fractured race bearings is also included.

Servo System Paper

Richardson Scale Co., Van Houten Ave., Clifton, N. J., offers a new four-page technical reference that pictures and describes a recently-developed servomechanism system which has as its components a synchro-mechanism, control transformer (balancing synchro), servo amplifier and servo motor.

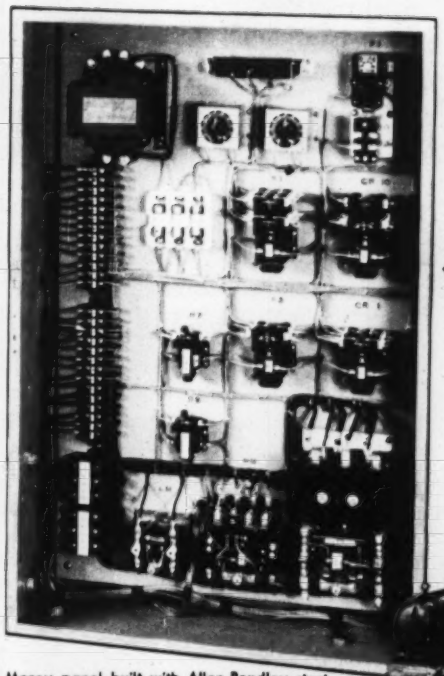
The technical reference, 54 B, includes photographs and engineering drawings of key parts, and contains a diagrammatic layout showing how parts are hooked up. Listed in the reference are ten new uses for the system, including non-weighing or general processing applications and weighing operations. Information is also included on how remote recorders and tape printers may be hooked up and synchronized with servo units.

High Capacity Gearing

A quick picture of the product design improvement opportunities offered gear users through the size, capacity and cost advantages of Duti-Rated lifetime gearing is presented in a new booklet published by Foote Bros. Gear and Machine Corp., 4545 S. Western Ave., Chicago 9, Ill.

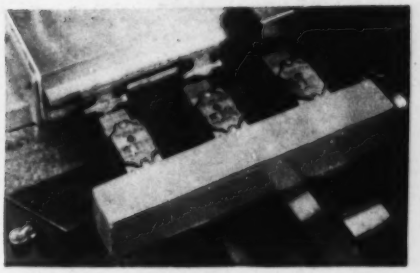
The booklet contains comparative photographs of a heavy-duty transmission before and after application of gearing, and illustrates other case study applications of the company's gearing in such fields as materials handling equipment, pumps, food and chemical processing, machine tools and farm equipment. Typical ratings are charted for sizes of Duti-Rated gears now in production. Another chart compares the hardness and wear life of soft, ordinary, ordinary-hard, and Duti-Rated gearing.

Continued on Page 71

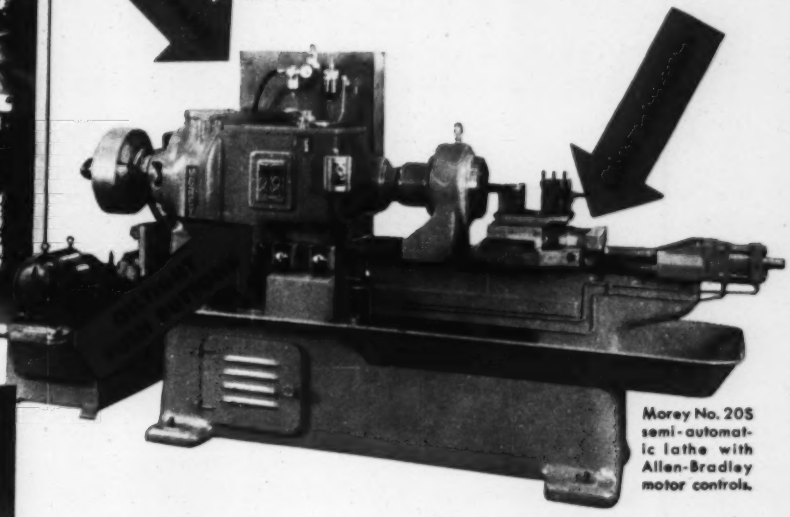


Morey panel built with Allen-Bradley starters, relays, timers, and terminal blocks.

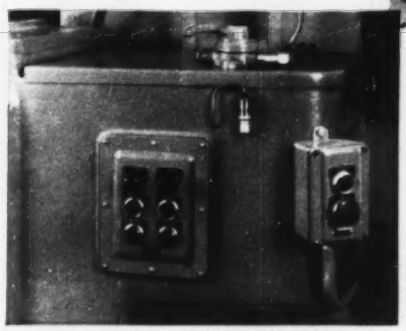
Bulletin 802T Type D oiltight limit switch.



Three Bulletin 802T oiltight limit switches on Morey semi-automatic lathe for limiting travel of tool holder.



Morey No. 20S semi-automatic lathe with Allen-Bradley motor controls.



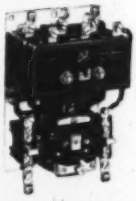
Close-up of Bulletin 800T oiltight push buttons on Morey lathe. They control spindle and pump motors.

Add a Sales Asset to your Machine Tools by standardizing on A-B MOTOR CONTROLS

With the growing trend toward AUTOMATION, electric motor controls are items of critical interest to machinery buyers. They recognize the A-B trademark as a label of QUALITY for the Allen-Bradley starters, relays, contactors, timers, drums, limit switches, and push buttons. So, why not standardize on Allen-Bradley motor controls and enjoy the benefits of a prestige line of quality control units? It will not only assure reliable performance of your machines but add another touch of quality appearance . . . a distinct sales asset.

An Allen-Bradley sales engineer will gladly recommend the best combination of controls for the maximum output of your machines. Why not phone your nearest Allen-Bradley office, today?

Allen-Bradley Co., 1316 South Second St., Milwaukee 4, Wisconsin



Bulletin 709 Size 2 solenoid starter.

Bulletin 709 Size 1 solenoid starter.

Bulletin 700 solenoid relay—Universal type.

Bulletin 849 pneumatic timing relay.

ALLEN-BRADLEY

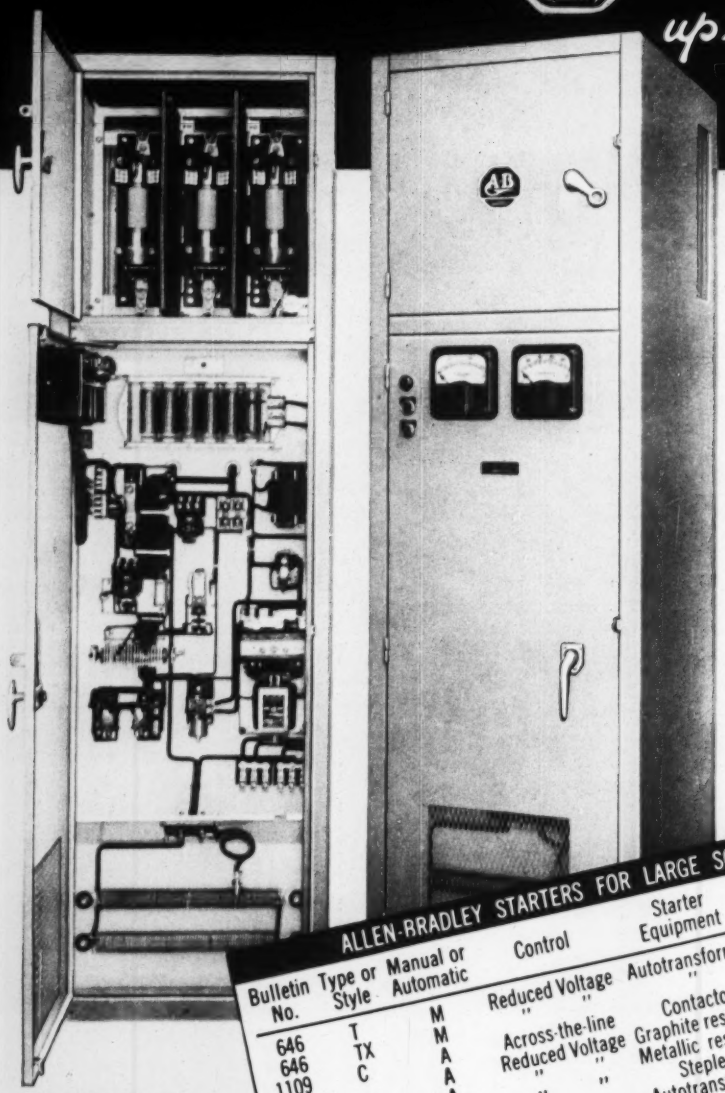
QUALITY

MOTOR CONTROL

A-B Quality

8-54-R

STARTERS up to 1500 HP



There are 14 different types of these rugged Allen-Bradley starters. (See listings below.) Some are of the across-the-line type . . . but most of them are reduced voltage starters using resistors, transformers, or reactors during the starting period.

These starters are available in 2500 to 4600 volt ratings for squirrel cage motors from 700 to 1250 hp, and for synchronous motors from 800 to 1500 hp. They are listed for squirrel cage motors from 125 hp, 220 v to 600 hp, 440-550 v, and for synchronous motors from 350 hp, 220 v to 700 hp, 440-550 v.

For complete details, please send for the A-B Handy Catalog.

ALLEN-BRADLEY STARTERS FOR LARGE SQUIRREL CAGE MOTORS

Bulletin No.	Type or Style	Manual or Automatic	Control	Starter Equipment	Maximum Horsepower at Rated Voltage 220V	440-550V	2000-2500V	2501-4600V
646	T	M	Reduced Voltage	Autotransformer	125	250	700	1250
646	TX	M	" "	"				
1109	C	A	Across-the-line	Contactor		200		
740		A	Reduced Voltage	Graphite resistors	200	600		
741		A	" "	Metallic resistors	300	600		
742		A	" "	Stepless				
746		A	" "	Autotransformer	300	600	700	1250
1146	CT	A		"				

ALLEN-BRADLEY STARTERS FOR LARGE SYNCHRONOUS MOTORS

Bulletin No.	Type or Style	Manual or Automatic	Control	Starter Equipment	Maximum Horsepower at Rated Voltage 220V	440-550V	2000-2500V	2501-4600V
906	A	A	Across-the-line	Contactor	350	700	800	1500
906	C	A	" "	"				
914		A	Reduced Voltage	Resistors	250	250		
922	AT	A	" "	Autotransformer	350	700	800	1500
922	CT	A	" "	"			800	1500
922	CR	A		Reactor				

8-54-R

Bulletin 906 Style C high voltage synchronous motor starter with current-limiting fuses. Self-protecting against short circuits up to 150,000 kva on 2500 volts or 250,000 kva on 2501 to 4600 v. The high tension, solenoid operated, across-the-line oil-immersed switch is mounted in oil tank behind the panel. Cabinet has hinged doors on front and back.

Allen-Bradley Co.
1316 S. Second St., Milwaukee 4, Wis.

ALLEN-BRADLEY

QUALITY

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Engineering Careers

Opportunities for mechanical engineers at E. I. DuPont de Nemours and Co., Inc., are outlined in a new 28-page bulletin announced as available by the company.

The booklet, directed to college engineering students, discusses and illustrates career opportunities in mechanical engineering jobs at DuPont in research, development, plant engineering, and production supervision.

Fire Centrifugal Pumps

Specifications for Wheeler-Economy centrifugal fire pumps, centrifugal booster pumps and tank filling pumps are included in a bulletin issued by Economy Pumps, Inc.

The bulletin also includes a guide for writing a fire pump specification. Diagrams of typical fire pump installations are included. Copies may be obtained by writing to Economy Pumps, Inc. Div. of C. H. Wheeler Mfg. Co., 19th and Sedgley Ave., Phila. 32, Pa.

Speed Reducers Bulletin

Bulletin HW 654 published by Winsmith, Inc. presents the new "C" line of Winsmith worm gear speed reducers. Key features are concisely described, and photographs and drawings illustrate each of the three designs in the line, "CB", "CT", and "CV."

Detailed dimension and specification tables cover the first five sizes which are now available to meet requirements within the 1/100 to 5 hp range, in ratios of 5:1 to 60:1. A copy of the bulletin can be obtained from Winsmith, Inc., Springville, N. Y.

Lathe Attachment

A new 16-page Axelson Trace-O-Matic hydraulic tracer attachment bulletin describing this attachment which may be applied to Axelson heavy duty lathes for duplicating turned parts from inexpensive flat templates is now available. The bulletin includes information regarding set up, how to make the plates, and two pages of case histories showing the high production performance that can be obtained with lathes equipped with the attachment from Axelson Mfg. Co. Div., Pressed Steel Car Co. Inc., 6160 S. Boyle Ave., Los Angeles 58, Calif.

Additional Opportunities are offered in the display advertisements— on pages 46, 61, 62, 64, 66, 68, 72, 73, 133

Does temperature or pressure control enter into your design problems?

See how this bellows engineer can help you!

● He'll work with you on a bellows assembly design for *your* specific requirements. He'll know the kind of bellows metal you need—brass, stainless steel, monel or nickel. He'll recommend the correct bellows charge—volatile liquid or gas.

He'll give you this and other important recommendations about bellows assemblies—to help your products perform more efficiently.

Sylphon and Bridgeport bellows assemblies are used in many ways—for thermostatic devices, pressure controls, hydraulic mechanisms, expansion joints, motion transmission, as flexible connectors and in more applications.

Let our engineers, our half-century of experience and ample production facilities work for you—save you valuable time and cut your costs. Write Department TK today.

MR. D. D. GORDON, of our engineering staff, specialist in bellows applications.

TYPICAL SYLPHON AND BRIDGEPORT BELLOWS ASSEMBLIES

SEND FOR FREE BULLETIN

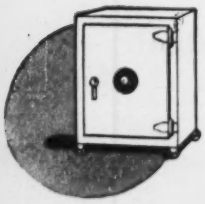
Idea-filled Bulletin tells you all about metal bellows and bellows assemblies. Send for your free copy today. Ask for Catalog 1400.

Robertshaw-Fulton

CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION
BRIDGEPORT 1, CONNECTICUT

FULTON SYLPHON DIVISION
KNOXVILLE 1, TENNESSEE



Everyone knows this
is a sign of security . . .

And smart gear users know
this CINTI is the sign of
the best in custom made gears.

May We Send You Our Brochure?

CINTI "Gears . . . Good Gears Only"

THE CINCINNATI GEAR CO. • CINCINNATI 27, OHIO

JOIN RCA ENGINEERING MANAGEMENT

RCA has two engineering management openings in its expanded electronics engineering program:

Manager Missile Guidance Systems Projects (*to supervise circuit development engineering, systems analysis and coordination of design for missile guidance*).

Administrator Mechanical Design (*to coordinate design effort of Engineering Staff for best practical mechanical design*).

These positions require the ability to manage a comprehensive design and development engineering organization and to plan broad engineering programs. Your ability should be substantiated by proven supervisory experience and a degree in EE, ME, or Physics.

Send a complete resume of your education and experience to:

Mr. John R. Weld, Employment Manager
Dept. B-483H, Radio Corporation of America
Camden 2, New Jersey

RCA **RADIO CORPORATION OF AMERICA**
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Gasket Bulletin

"How Flange Surface Finishes Affect Gasket Sealability and Joint Performance" is the latest in a series of illustrated technical bulletins being issued by Johns-Manville, printed in booklet form under the collective title "The Gasket."

The most recent bulletin discusses the effect of flange surface finishes upon the performance of a gasket. It provides a basis upon which to select the flange surface finish most suitable for a given gasket, and explains why the right finish makes it easy to achieve an initial seal and obtain the best joint performance in service. Copies are available from Johns-Manville, 22 East 40th St., New York 16, New York.

Water Heater Catalog

A catalog of product bulletins has been compiled and announced as available from Yula Water Heaters, Inc., 166 W. 225th St., New York 63, N. Y.

Included in the catalog are data and specifications on Freeon coolers, convertors and condensate coolers, heat exchangers, submerged water heaters, fuel oil detectors, straight tube fuel oil heaters and instantaneous water heaters. The material contains dimensions and operating data of the company's various products.

A-C Rate Generator

A four-page, two-color bulletin illustrating and describing a line of extremely stable, linear, a-c rate generators with high functional voltage output has been published by Ford Instrument Co. These units are offered in 60 cycles and 400 cycles models and are available with temperature compensation for a wide environmental operating range.

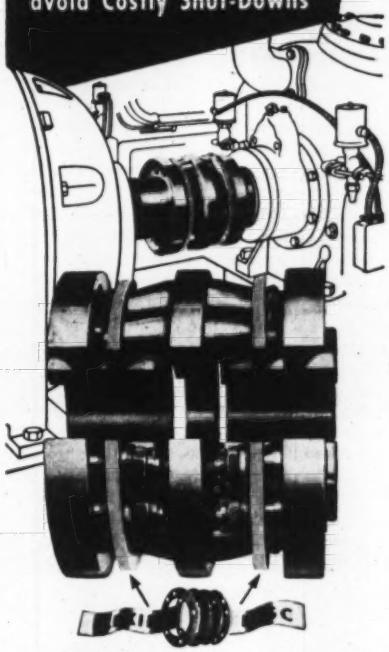
Information on construction, applications and design features and characteristics and specifications are provided. Also included is a section on rate generator-servo motor packages, which combine, in single-shaft units, rate generators and high-precision servo motors. The bulletin is available from the company, 31-10 Thomson Ave., Long Island City 1, N. Y.

Multi-V Drive Handbook

A 76-page, illustrated multi-V-belt engineering handbook, featuring a convenient guide to the design of standard and high capacity drives, has been published by the B. F. Goodrich Co., Industrial Products Div., Akron, Ohio.

New horsepower rating tables closely approximate actual operating conditions and reflect the increased ability of modern belts. Other subjects covered include selection of correct multi-V drives, installation and care of V-belt drives, principles of V-belt design, selection of pre-engineered V-V drives, designing a standard V-V drive not in pre-engineered tables, designing V-flat drives, multi-V quarter turn drives and double-V-belt drives. A multi-V-belt drive calculation sheet is also included.

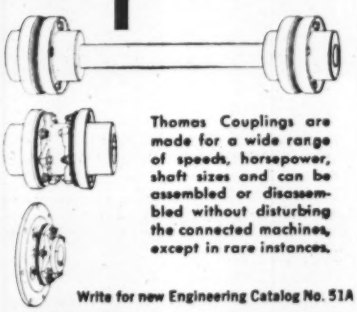
Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

DISTINCTIVE ADVANTAGES

FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Thomas Couplings are made for a wide range of speeds, horsepower, shaft sizes and can be assembled or disassembled without disturbing the connected machines, except in rare instances.

Write for new Engineering Catalog No. 51A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

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Blast Cleaning Bulletin

Pangborn Corp., Hagerstown, Md., has announced the publication of bulletin No. 226 which describes the various models of Continuous-Flo Rotoblast barrels available for production line blast cleaning to reduce cleaning costs.

The company says the machines have been developed to overcome the disadvantages of batch blasting in plants which have large and continuous production where the great need is for cleaning capacity that can match production. They are said to be able to handle a continuous flow of work coming from the preceding operation, castings from the shakeout, forgings from heat treatment, and stampings from the presses.

Boiler Water

The need for proper "designing" of the mineral content of boiler water to prevent boiler losses due to corrosion and scale is described in a new six-page folder issued by Hall Laboratories, Inc.

Tracing methods of research and pretreatment of water, the new folder, "Boiler Water," points out the special knowledge and experience required to determine just what an industrial boiler needs to make steam of the required purity at minimum cost and maximum protection against boiler failure. New plants or expansions introduce new questions and water design methods must constantly be reviewed, it is related. The folder is available from Hall Laboratories, Inc., Hagan Bldg., Pittsburgh 30, Pa.

Steam Costs Bulletin

"Have You Checked Your Steam Costs Lately?" is the title of a light 16-page picture and caption presentation published by Orr & Sembower, Inc., Reading, Pa., manufacturers of packaged automatic boilers.

The first part of the book consists of drawings and captions emphasizing typical boiler plant problems. The latter part of the book illustrates and describes many different types packaged automatic boiler installations in industrial plants, public utilities, food processing, textile, hospital, school, laundry, apartment, and hotel applications.

Valve Catalog

A 34-page catalog covering manual, solenoid, and solenoid pilot controlled valves, and pressure switches has been announced as available from Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif.

The catalog describes the company's "Shear-Seal" principle which consists primarily of a pressure balanced, self-aligning tubular valve seat that is constantly in perfect contact with an optically flat porting disk or rotor containing flow passages. In addition to illustrations and specifications of valves, the booklet also contains a section on the proper selection of pressure switches. Ordering information, operating data, and flow patterns of the various valves are listed.

DESIGNERS

for layout and design of electronic and mechanical components of radar systems and computing equipment.

1
THE COMPANY

Hughes Research and Development Laboratories form one of the nation's leading electronics organizations. The Laboratories are presently engaged in development of advanced electronic systems and devices produced by the Hughes manufacturing divisions.

2
AREAS OF WORK

The work calls for layout and production design of: 1. Reliable, maintainable electronic units. 2. Unique electromechanical devices. 3. Installations of electronic equipment in interceptor airframes.

Relocation of the applicant must not disrupt an urgent military project.

3
THE FUTURE

Designers experienced in the field of electromechanical design for production, or those interested in entering this field, will find outlets for their abilities and imagination in these active areas. New electromechanical techniques are opening new applications of airborne electronic equipment. Hughes designers will have the benefit of working experience in these fundamental developments.

Scientific and Engineering Staff

HUGHES

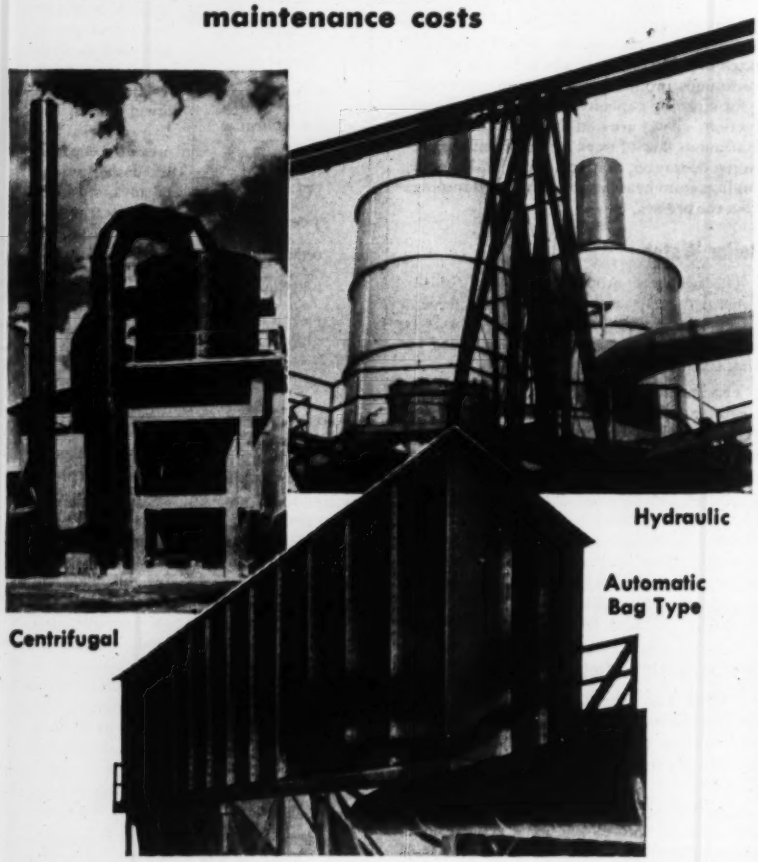
RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

Norblo

Dust and Fume Collection Systems

make outstanding records for high recovery with low operating and maintenance costs



Hydraulic

Automatic Bag Type

Centrifugal

These three important types of Norblo collecting systems, frequently used in certain combinations, bring you economical, dependable control as required in a wide range of industries. "Guaranteed Efficiency" is not an empty phrase at Norblo. We stand back of every installation that's used for the purpose and at the capacity for which we designed it. All component parts are made by Norblo, under controlled specifications.

For more than 40 years Norblo has engineered and supplied installations of every size in the rock products, smelting, chemical, metal working, milling and processing fields. It pays you to get the facts about Norblo Dust and Fume Collecting Systems. Give us a description of your problems.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

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Electronic Information Storage System

A method of electronic information storage that is claimed to provide users with an open door to complete automation is described in a four-page illustrated pamphlet issued by Logistics Research, Inc., Redondo Beach, Calif.

The pamphlet describes technical functions of the "Magnetic Library System," and outlines its application in such varied operations as accounting, production, and inventory control, and preparation of reports.

The LRI innovation consists of an electronic digital computer and a memory wheel working in conjunction with commonly used office machines. According to LRI scientists, the system can file more than two million decimal digits far more efficiently than standard filing cabinets.

Copies of the pamphlet are available from Logistics Research, Inc., 141 So. Pacific Ave., Redondo Beach, Calif.

Power Transmissions

A newly revised eight-page, two-color, $8^1/_2 \times 11$-in. catalog, B20-53, describing the complete line of Morse mechanical power transmission products is now available from Morse Chain Co., 7601 Central Ave., Detroit 10, Mich.

The catalog describes and illustrates silent chain, roller chain, and Hy-Vo drives; sprockets, cable chains, drive shafts, couplings, and clutches. New information is included in the catalog on Taper-Lock sprockets, cam clutches and torque limiting clutches. Brief specifications, stock sizes, applications, and descriptions are included for each product.

Pneumatic Controller Catalog

Stack-type pneumatic controllers for process variables are illustrated with cut-away construction photos, schematic diagrams, and dimension drawings in Fischer & Porter 12-page catalog 53-10.

Specifications, controller response actions, and a controller selection guide cover complete details of case-mounted, field-mounted, and valve-mounted control instruments. The catalog can be obtained by writing to Fischer & Porter Co., 148 Jacksonville Rd., Hatboro, Pa.

Wire Thread Inserts

A bulletin, No. 708, for designers, fastening engineers, production executives, and users of wire thread inserts has been announced by the Heli-Coil Corp. of Danbury, Conn. It presents basic information on Heli-Coil wire thread inserts and tools in condensed form.

Twenty illustrations and five tables present data and installation instructions on inserts and tools for national coarse and fine, unified coarse and fine, spark plug and pipe thread series. Inserts are listed in sizes from No. 4 through $1^1/_2$ in. in diam and for 3, 3B, 2, and 2B class of fit.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Hot Extruded Shapes

Allegheny Ludlum Steel Corp. has announced as available its first literature describing new hot extruded shapes it is offering in stainless, tool steels, high temperature alloys, and other steels.

The leaflet describes advantages in purchasing extruded shapes that can be closer to finish sizes than for regular hot rolled materials, reduced scrap losses, advantages in small quantity production, and the fine physical characteristics of the extruded shapes. Illustrations of shapes already produced are also included. Copies may be obtained from the company, 2020 Oliver Bldg., Pittsburgh 22, Pa.

Service, Facilities Brochure

A Brochure featuring a reference chart on the composition of zinc and aluminum alloys for die casting and a specific gravity chart has been issued by National Die Casting Co., 3635 W. Touhy Ave., Chicago 45, Ill.

Additional information includes photographs and description of the company's die making facilities, die casting machines, and machining facilities. The booklet covers every phase of the company's complete quality-controlled zinc and aluminum die casting service.

Automation Booklet

"Tools of Automation," a new 12-page booklet issued by Reliance Electric and Engineering Co., 1076 Ivanhoe Rd., Cleveland, Ohio, expresses the company's philosophy of combining applied engineering, creative thinking, and electric motor drives to provide the "know-how" for automation of single machines or continuous processes.

Individual booklet divisions illustrate choosing the right motor for the job, adjustable-speed V*S drives as a tool of automation, and electronic controls and regulators that provide precise, accurate motor drive control and regulation. Also included are photographs which illustrate automation at work in many industries.

Relief Valves

Catalog sheets describing a new line of differential piston-type relief valves, are available from Fluid Controls, Inc., 1284 N. Center St., Mentor, Ohio. The valve, recommended by the company for critical applications in which failure to hold pressure is hazardous, is described in a detailed cross-section drawing.

The literature also includes a diagram illustrating its use in a typical circuit, and charts listing its operating features.

Hydraulic Pump Data

The new Aldrich air driven hydraulic pump is described fully in Data Sheet 36, just published by the Aldrich Pump Co., Allentown, Pa. Material includes information on design, installation and operation, and is illustrated by photographs and sectional and dimensional drawings.

The pump is designed to meet demand for small volume capacity at low and high pressures, and is available in either single or double-acting models. It is said to develop up to 30,000 psi at 90 psi air supply for such applications as testing tubing, valves and pressure vessels, and supplying power for small molding presses.

Filtering Bulletins

General Filter Co., 923 Second St., Ames, Iowa, has issued two new bulletins on Pneumatic operated control for all phases of the water treatment process requiring instrumentation for measurement and control.

Bulletin No. 5421 describes the system, and No. 5422 is an engineer's manual. The system consists of five basic elements: a primary element, a converter-transmitter, a measuring instrument, a controller, and a final control element such as a diaphragm motor valve.

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SPRAYING SYSTEMS CO. CATALOG NO. 24

48 pages of spray nozzle reference data . . . the most complete catalog of its kind ever produced.

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. . . his specialized experience is yours for the asking.

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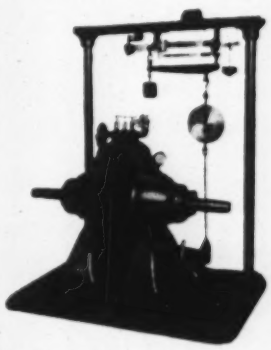
Engineers and Manufacturers

3265 Randolph Street • Bellwood, Illinois

Hydraulic Dynamometers for EXACT PERFORMANCE DATA on prime movers



HI-EFF

Write for Bulletin No. 760

You can depend on the performance data taken from a Taylor "HI-EFF" Hydraulic Dynamometer. Efficient, compact Taylor "HI-EFF" offers the most economical investment and maintenance cost per hour. 72 different capacity models each with wide range of h.p. and speed. Capacities from fractional to 10,000 h.p. Speeds from 0 to 25,000 r.p.m. Reversible if desired. Taylor engineers will be glad to make recommendations.

• Dynamometers • Static Balancers
• Precision Drilling Machines

TAYLOR DYNAMOMETER & MACHINE CO.

6411 RIVER PARKWAY MILWAUKEE 13, WIS.

Space Heaters

Bulletin No. 552, released by Dravo Corp., Heating Dept., 1203 Dravo Bldg., Pittsburgh 22, Pa., describes a line of "Paraflo" warm-air, oil or gas fired space heaters designed specifically for commercial and industrial establishments.

The 8-page booklet illustrates design and construction features, shows application and installation information, and gives engineering data on these 200,000 or 250,000 Btu per hour capacity heaters. They are designed for commercial applications such as supermarkets, service stations, garages, show rooms, recreation centers, stores, offices, agricultural buildings, warehouses, and a wide variety of industrial plant applications.

Air Data Computer

Servomechanisms Inc., has compiled an eight-page technical brochure on its master air data computer. The brochure points out that the computer provides a single coordinated source of information, eliminating much duplication. Schematic diagrams show how the plug-in type computer permits calculation of complex functions with a minimum of equipment. It is available from Servomechanisms Inc., Westbury, L. I., or El Segundo, Calif.

Shaper Line Bulletin

Ready for distribution is a 12-page bulletin, No. 1800-54 summarizing the Michigan Tool Shear-speed shaper line. This literature outlines in detail the company's process for cutting gears, splines, cams, sprockets, and miscellaneous external shapes, one or several at a time.

Specifications for each model in the line are presented in table form. Among these machines is the new heavy-duty 18105-HD, which is capable of cutting gears with diameters up to 10 in. and face widths up to $4\frac{1}{2}$ in. Included in the bulletin is information regarding tooling, accessories, machine operation, controls, feeds, and several interesting typical applications. The bulletin is available upon request from the company at 7171 E. McNichols Rd., Detroit 12, Mich.

Clutch-Coupling Units

A four-page brochure on the new line of Formsprag clutch-coupling units is now available from Formsprag Co., 23601 Hoover Road, Van Dyke, Mich. The brochure gives dimensional data, service factors, and all other application engineering data necessary to specify the right clutch-coupling unit.

Electric Motor Catalog

A new multi-color booklet, No. 1878, illustrating the 20 principal types of improved U. S. motors has been announced by U. S. Electrical Motors, Inc., Box 2058, Los Angeles 54, Calif. Illustrated are uniclosed, totally-enclosed, explosion-proof with and without fan, varidrive, syncrogear, combination variable speed and internally geared units, right-angle worm gear, verticlosed hollowshaft, vertical solid shaft, test stands and aircraft.

Also included are AutoStart buffers, right-angle holloshaft gear drive for turbine pumps, and details on Lubriflush transverse bearing lubrication, asbestos-protected windings and normalized motor castings.

Boiler Blowdown Control

"Boiler Blowdown Control" is the subject of Technical Paper No. 128, prepared by W. H. and L. D. Betz, Gillingham & Worth Sts., Philadelphia 24, Pa. Principal types of boiler blowdown are discussed, as well as various control methods necessary to assure production of pure steam and the keeping of heat transfer surfaces free of scale and other objectionable deposits. Copies of the paper may be obtained by writing to the company.

Model 10VA

One of the Ten Models of ALL AMERICAN Vibration Fatigue Testing Machines

The "10VA" produces vibration vertically in simple harmonic motion—from 10 to 55 cycles per second on automatic control and from 10 to 60 c.p.s. on manual control. Table load capacity 10 lbs. at 10g. Has 50% overload factor. Tests components, assemblies, products—exposes danger points—forestalls failures in the field. Simple to operate. Essential for today's inspection, testing, research. Also models with horizontal table motion. Send for Bulletin 551.

Manufacturers of All American Precision Die Filing Machines

ALL AMERICAN Tool & Manufacturing Co.

8019 Lawndale Avenue, Skokie, Ill.

MARK FLATS AND ROUNDS

THE SAFE EASY WAY

Designed for marking hot or cold products, this unit features a reinforced outer box which levels the type holder on the piece being marked. The type holder is made of Mecco Safety Steel to give maximum resistance to spalling and mushrooming—thereby assuring greatly increased service life. Made for any size type.

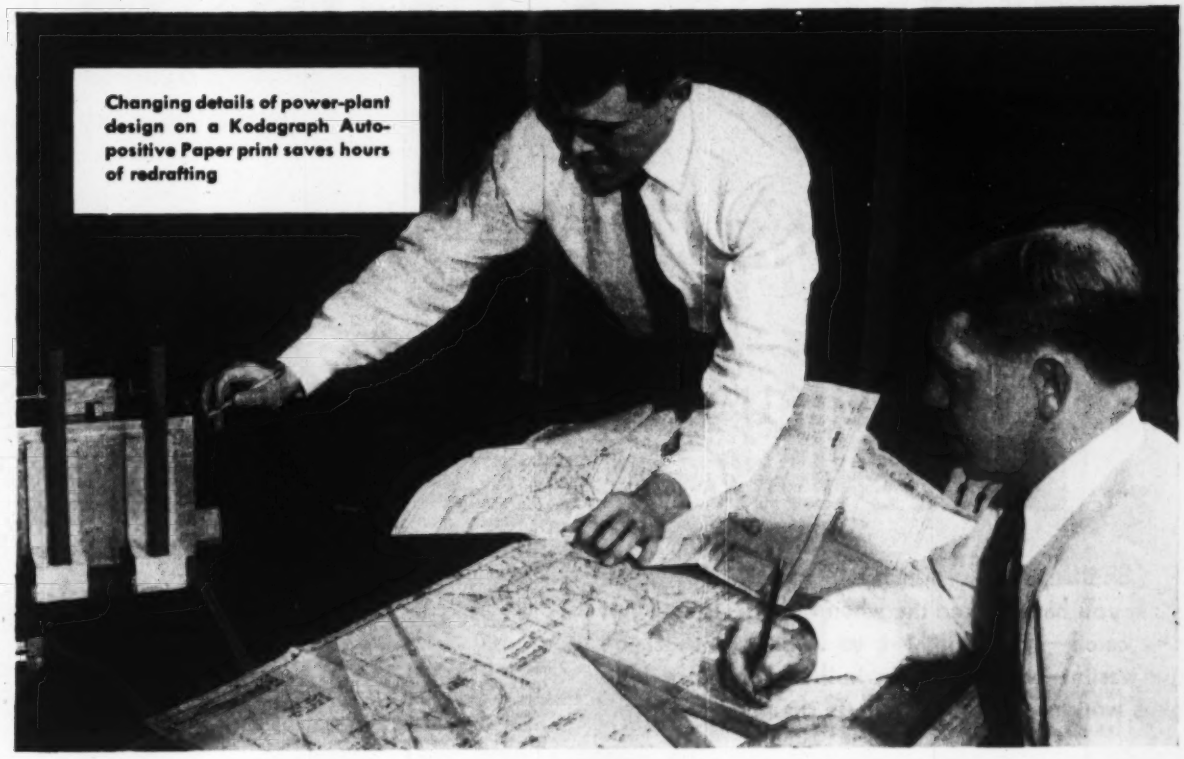
Write for literature

Mecco SAFETY BOX TYPE HOLDER

Mecco SAFETY MARKING TOOLS

M.E.CUNNINGHAM CO.

1473 NORTH AVENUE, PITTSBURGH 33, PA.



Changing details of power-plant design on a Kodagraph Autopositive Paper print saves hours of redrafting

Toledo Edison Company reports on its use of Autopositive—

"One saving after another since 1947"

Shortly after Kodagraph Autopositive Paper was introduced, the Toledo Edison Company, Toledo, Ohio, began exploring its possibilities for engineering drawing reproduction.

Here was a revolutionary photographic intermediate paper which produced positives directly from positives—no negative step. It could be exposed in standard print-making equipment . . . processed in standard photographic solutions. *Entire operation in ordinary room light, too.* Jobs which had been difficult and costly became easy and economical—Kodagraph Autopositive Paper costs only a few cents a square foot. Some typical savings at Toledo Edison *which you can duplicate* are listed here.

☐ **Old prints and intermediates reclaimed.** No time lost retracing. Autopositive Paper strengthens weak line detail, cleans up backgrounds. Toledo Edison now can get intermediates which have dense photographic black lines on an evenly translucent paper base. *Original quality or better!*

☐ **Opaque originals no problem.** Many of Toledo Edison's forms, charts, operating maps, etc., are on opaque stock—some two-sided. Data is added to these in pencil or by typewriter. Then Autopositive reproductions are made and used to produce the direct-process prints needed for distribution. The 1954 Annual Budget, for example, was reproduced in this manner. *Autopositive saves time and dollars for all departments.*

☐ **Print-making simplified.** Toledo Edison runs Autopositive intermediates at uniform, practical speeds in its direct-process machine . . . gets sharp prints time after time. *Autopositive lines do not smear, smudge, or lose density.*

☐ **Drafting shortcuts.** An Autopositive print is made of a drawing which has to be altered. The obsolete detail is eradicated or scissored out, and another Autopositive is made. New design is then added, and the job is completed without redrafting.

☐ **Photo-lasting file copies.** Toledo Edison also finds that Autopositive intermediates will not turn yellow or become brittle . . . are ready to produce sharp, legible prints whenever needed.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

Shows all the ways you can save with Kodagraph Autopositive Paper.

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Industrial Photographic Division, Rochester 4, N. Y.
Gentlemen: Please send me a copy of "Modern Drawing and Document Reproduction."

Name_____ Position_____
Company_____ Street_____
City_____ Zone____ State_____

Kodak

STUDENT MEMBERS
OF THE ASME

you can get—

A LITTLE CASH!
A LITTLE FUN!
A LITTLE FAME!

HERE'S your opportunity to get that for which you have lacked the wherewithal. There's just one catch—you will have to work for it! If you quit easily—don't read any further. Perhaps a little extra work on your thesis will do the trick.

An engraved certificate signed by the President and Secretary of the Society will accompany each award.

A trip to the Annual Meeting as a guest of the "Old Guard" will be awarded.

Students should consult the Honorary Chairman regarding the rules for these awards. Only papers by single authors will be considered.

Each student must submit his paper to the Vice President of the Region in which his Student Branch is located not later than **May 15, 1955.**

$150.00

For the best paper by an undergraduate on the subject "The Atom and the Mechanical Engineer." This is the Charles T. Main Award.

An undergraduate must submit his paper for the Charles T. Main Award or Undergraduate Student Award before thirty days after the completion of his undergraduate work.

$25.00

For the best paper on an engineering subject by an undergraduate. This is the Undergraduate Student Award.

$25.00

For the best paper on an engineering subject by a graduate student. This is the Postgraduate Student Award.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

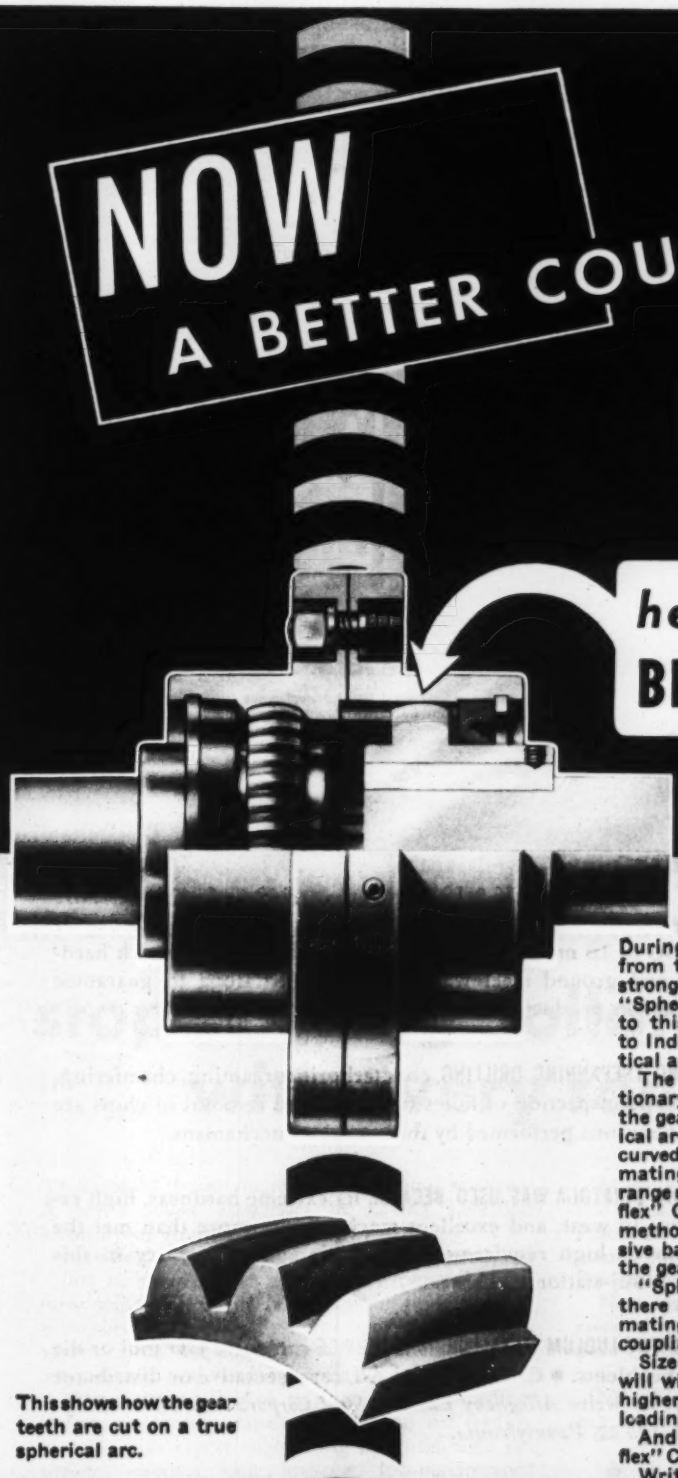
29 West 39th St., New York 18, N. Y.

NOW A BETTER COUPLING

SPHEREFLEX

here's the

BIG DIFFERENCE



This shows how the gear teeth are cut on a true spherical arc.

During recent years there has been a demand from the Aircraft Industry for a more flexible, stronger Gear Coupling. Although Philadelphia "Sphereflex" Coupling was developed in answer to this special need, it is now being offered to Industry in a complete line of standard, vertical and floating shaft couplings.

The "Sphereflex" Coupling utilizes a revolutionary new principle of coupling design, in that the gear teeth are precision cut on a true spherical arc. Since even the root of the gear tooth is curved, there can be no interference between mating gear teeth, even when shaft deflections range up to 7° total mis-alignment. The "Sphereflex" Coupling is in radical contrast to former methods of obtaining flexibility through excessive backlash or merely chamfering the tips of the gear teeth.

"Sphereflex" is a stronger coupling, because there is always a full line of contact between mating gear teeth, regardless of whether the coupling is flexed or perfectly aligned.

Size for size, the new "Sphereflex" Coupling will withstand more deflection, greater torque, higher rotating speeds, and more severe shock-loading than comparable couplings.

And remember, you pay no more for a "Sphereflex" Coupling than other good quality couplings.

Write for Catalog C-540.

PHILADELPHIA GEAR WORKS, INC.

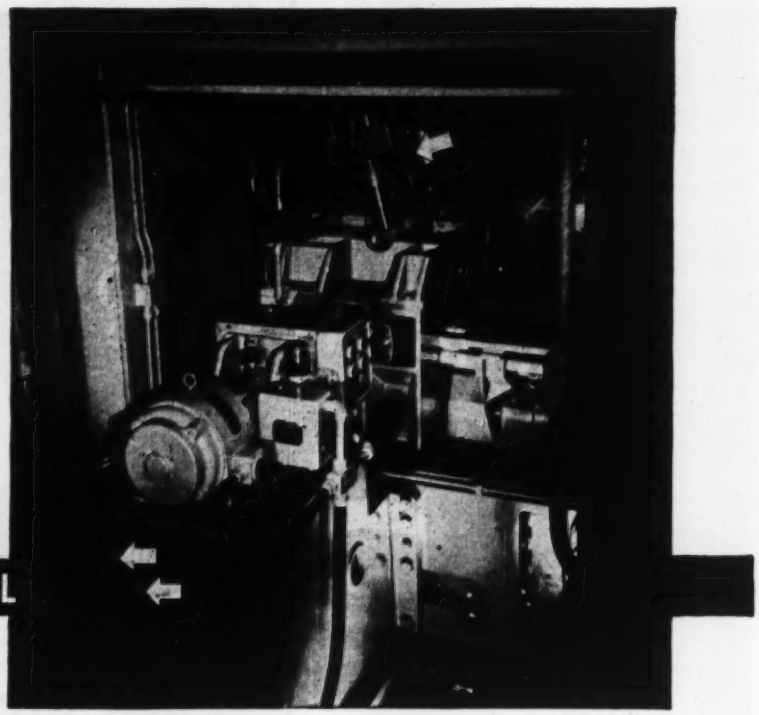
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA

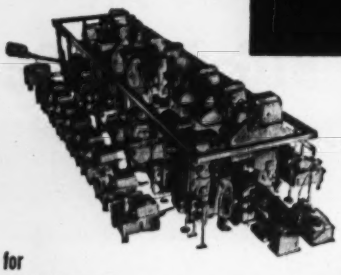
Industrial Gears & Speed Reducers

LimiTorque Valve Controls

50 Auto Blocks An Hour!

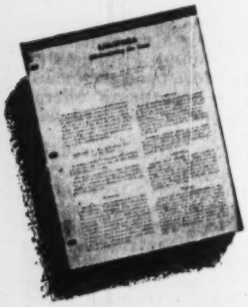
WITH THE HELP OF LUDLUM SARATOGA TOOL STEEL





Ludlum Saratoga was used for the steel ways (note arrows, above) of this giant unit, illustrated at left in a bird's-eye view reduced to miniature size.

Write for BLUE SHEET ON SARATOGA



This concise four-page folder gives all needed handling and shop treatment details on Saratoga. Included is certified laboratory information on physical characteristics, and complete data on forging, annealing, hardening, tempering, etc. *Ask for your copy.*

Address Dept. ME-58

98 SEPARATE OPERATIONS are carried on by this versatile machine which turns out 50 V8 auto engine blocks an hour. It consists of 18 machining units, each of which is fitted with hardened and ground steel ways of Ludlum Saratoga to guarantee accuracy in production.

MILLING, TREPANNING, DRILLING, counterboring, reaming, chamfering, automatic inspection of holes for depth and removal of chips are the operations performed by this amazing mechanism.

LUDLUM SARATOGA WAS USED BECAUSE its extreme hardness, high resistance to wear, and excellent machinability more than met the customer's high requirements for maintaining accuracy in this huge, multi-station machine.

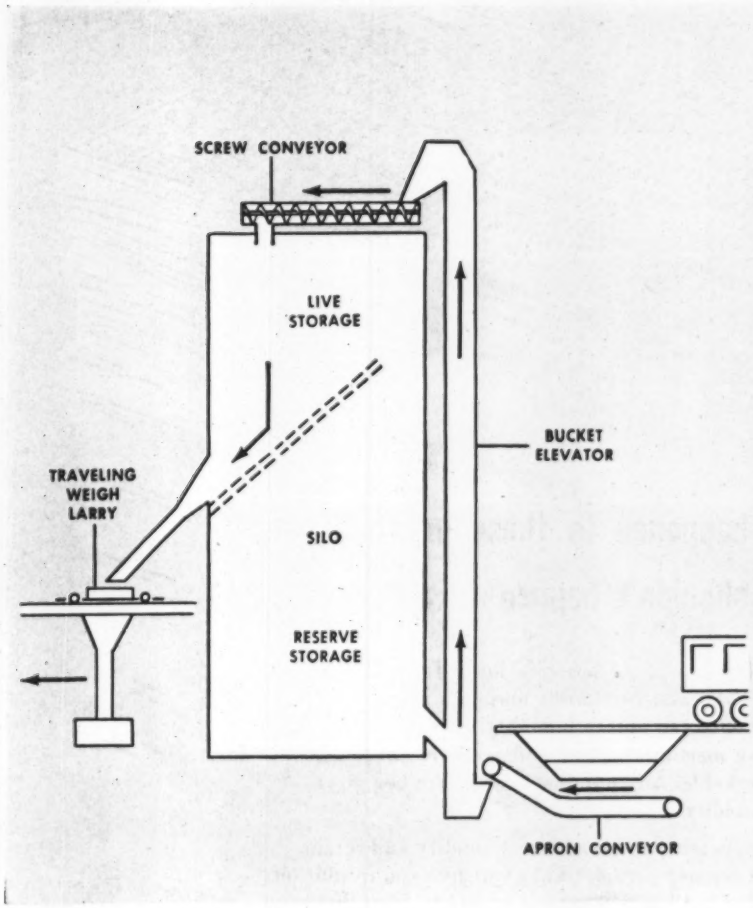
ALLEGHENY LUDLUM METALLURGICAL SERVICE can solve *your* tool or die steel problems. ● Call your local A-L representative or distributor today, or write *Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pennsylvania.*

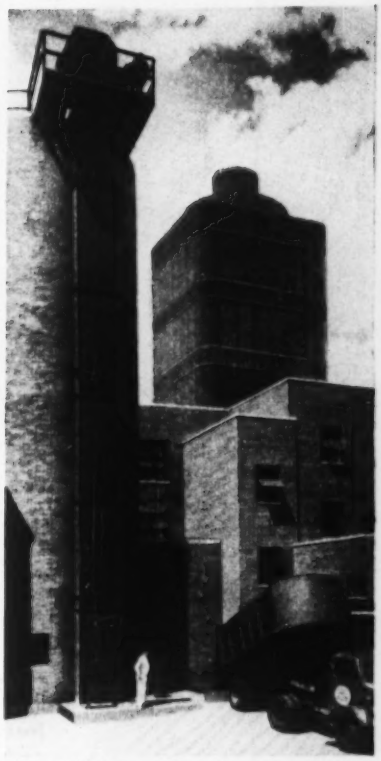
For complete **MODERN** Tooling, call

Allegheny Ludlum

WAD 8195

AL® FINE TOOL STEELS SINCE 1854





At S. C. Johnson & Son, Inc., Racine, Wis., Link-Belt bucket elevator raises coal to storage silo after it is dumped from trucks onto a Link-Belt apron conveyor. From elevator, coal is moved by a screw conveyor atop storage silo. Weigh larry delivers coal from storage silo discharge chute to any of three stoker hoppers.

With a Link-Belt coal handling system, your boiler house can

stop burning dollars needlessly with every ton of coal

FOR SMALL boiler house or large central station—there's *sound economics* in having Link-Belt furnish your entire coal handling system.

Link-Belt offers savings through its unmatched ability to engineer the right combination of equipment selected from its broad line of feeders, screw conveyors, bucket and Bulk-Flo conveyors, belt conveyors, apron and flight conveyors, carriers and all other related coal handling machinery.

This complete line of equipment for unloading, storing, reclaiming, conveying, elevating and feeding of coal—plus expert engineering based on wide experience—assures long, low-cost, low-maintenance operation.

Remember, too, Link-Belt accepts full responsibility for the complete design, manufacture, erection and satisfactory performance of the entire coal handling system.

In every segment of our American economy, you'll find Link-Belt playing an equally important role. Practically every raw material is transformed from its natural state to finished product with the aid of Link-Belt equipment.

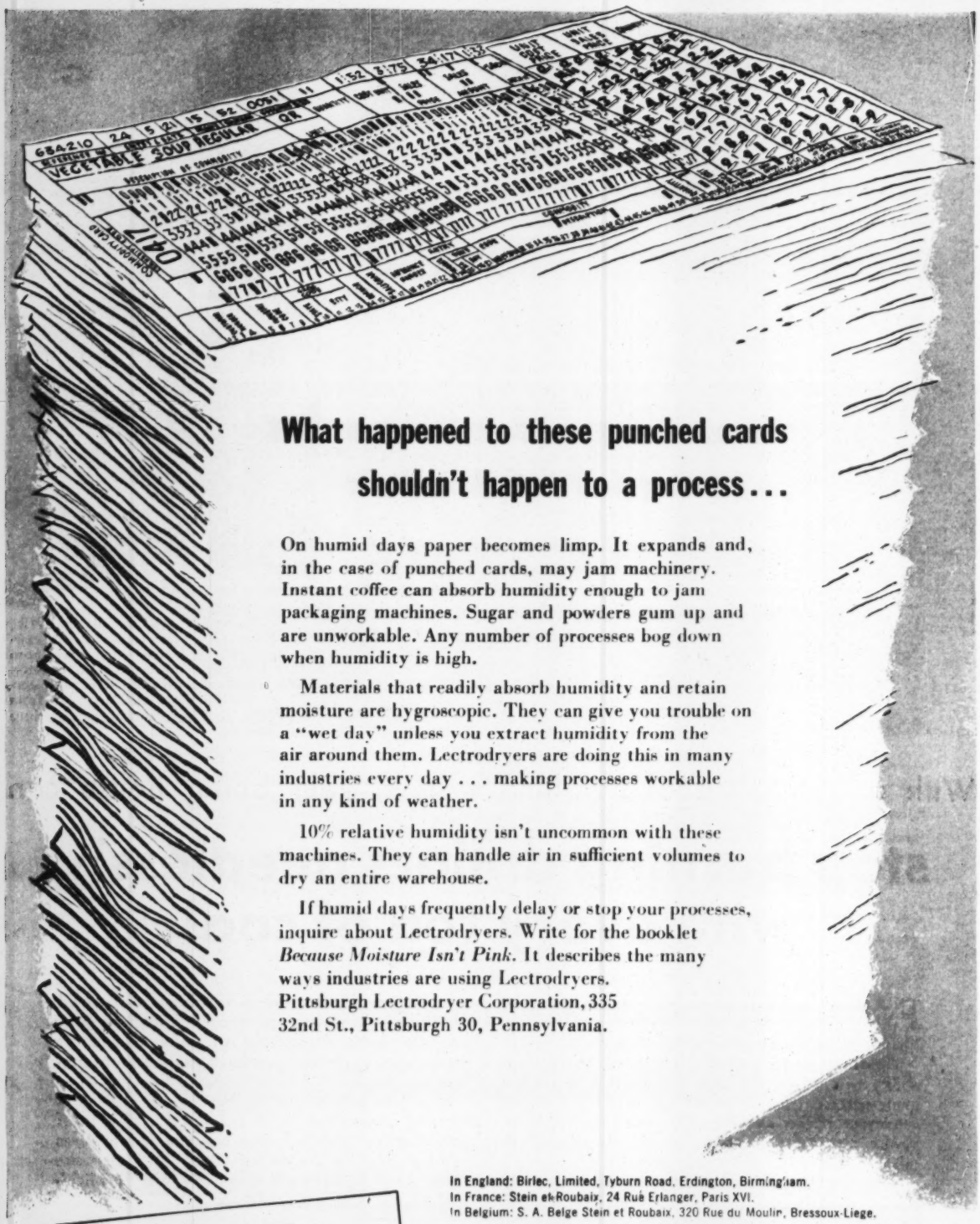
Next time you have a job that requires the movement of materials or the mechanical transmission of power, call the Link-Belt office near you. If it involves coal handling, ask for 44-page Book 2410. Or write LINK-BELT COMPANY, Dept. AV, 307 N. Michigan Avenue, Chicago 1, Illinois.

LINK-BELT

One source . . . one responsibility for materials handling and power transmission machinery

15.080

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



What happened to these punched cards shouldn't happen to a process...

On humid days paper becomes limp. It expands and, in the case of punched cards, may jam machinery. Instant coffee can absorb humidity enough to jam packaging machines. Sugar and powders gum up and are unworkable. Any number of processes bog down when humidity is high.

Materials that readily absorb humidity and retain moisture are hygroscopic. They can give you trouble on a "wet day" unless you extract humidity from the air around them. Lectrodryers are doing this in many industries every day . . . making processes workable in any kind of weather.

10% relative humidity isn't uncommon with these machines. They can handle air in sufficient volumes to dry an entire warehouse.

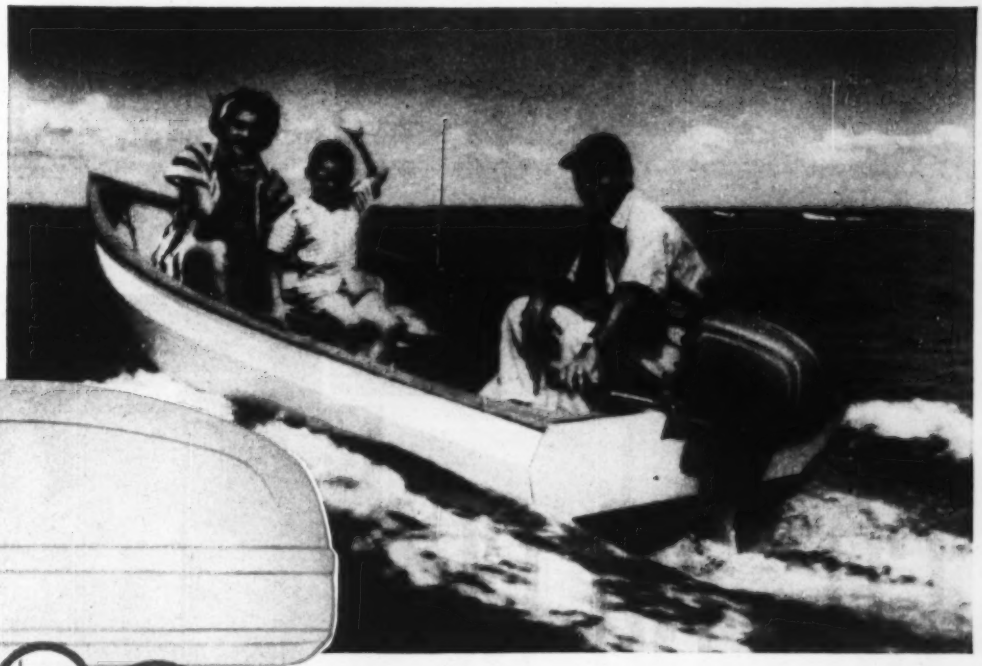
If humid days frequently delay or stop your processes, inquire about Lectrodryers. Write for the booklet *Because Moisture Isn't Pink*. It describes the many ways industries are using Lectrodryers. Pittsburgh Lectrodryer Corporation, 335 32nd St., Pittsburgh 30, Pennsylvania.

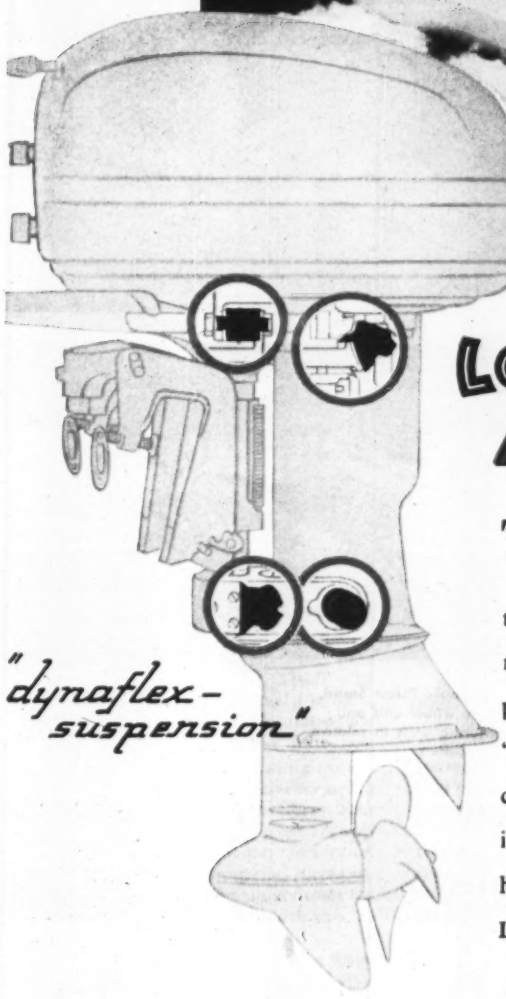
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U. S. PAT. OFF.





LORD
Hushes Horsepower....

THE new Lord Dynaflex Suspension, now being introduced on leading 1955 Model Outboard Motors, at last quiets the operation of powerful outboards. Ordinary conversation now can be heard easily. What's more, the Lord Dynaflex Suspension so completely eliminates vibration that uncomfortable "boat shake" is simply not there. Lord Engineers have worked closely with outboard motor designers, applying principles similar to those used in Lord Mounting Systems which pillow the huge engines in all modern airliners. Here again is proof that Lord Engineering controls Vibration . . . Anywhere.

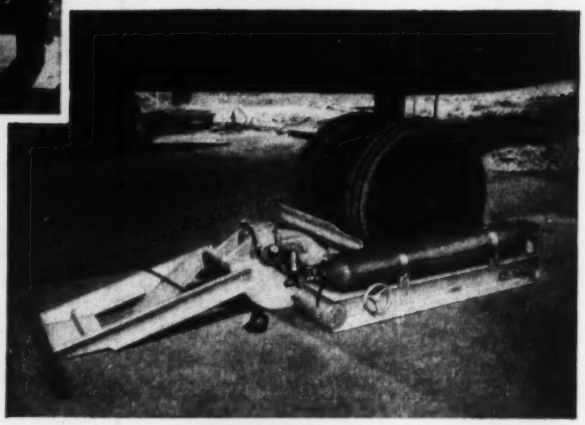
DETROIT 2, MICHIGAN 311 Curtis Building
LOS ANGELES 28, CALIFORNIA 7046 Hollywood Blvd.
CHICAGO 11, ILLINOIS 520 N. Michigan Ave.
CLEVELAND 15, OHIO 811 Hanna Building
PHILADELPHIA 7, PENNA. 725 Widener Building
NEW YORK 20, NEW YORK 630 Fifth Ave., Rockefeller Center
DALLAS, TEXAS 313 Fidelity Union Life Building
DAYTON 2, OHIO 410 West First Street

LORD MANUFACTURING COMPANY • ERIE, PA.

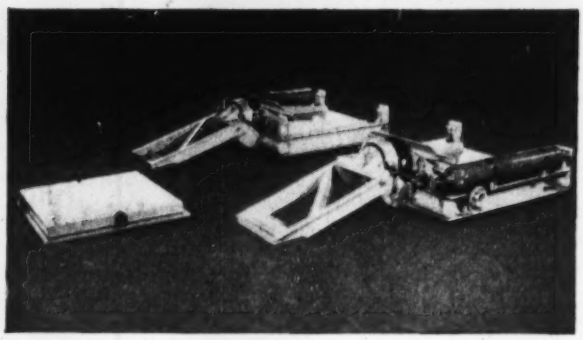
Over 27,000 designs and their variations from which to choose.

LORD — BONDED RUBBER

Headquarters for
VIBRATION CONTROL
FOR 30 YEARS



"GO" or "NO GO"



Complete Portable Thrust Stand, showing nose wheel unit and thrust measuring units in relative operating positions.

Thrust stands equipped with Hagan ThrusTorq units deliver direct, accurate readings of the actual performance of the plane engines under test. The pneumatic signals actuate indicators or recorders, either at the stand or remote, so that test personnel know instantly whether it is "go" or "no go" for the plane under test.

The portable stand, shown in the center and bottom photographs, requires only stop pieces bolted to the apron. The right and left wheel stands have their own supply of bottled nitrogen, used as a power source for the Hagan ThrusTorq. The stands can be set to suit the span of the landing gear. This stand measures a total thrust up to 25,000 pounds.

Maximum capacity is determined by the number and size of Hagan ThrusTorq units used in the assembly.

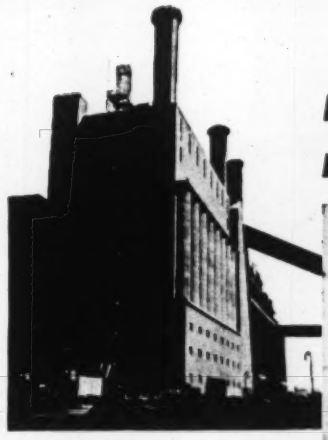
The Hagan ThrusTorq unit is fast, economical and clean. It is also used for thrust measurement of rocket and jet engines, and cradle dynamometer measurement of aircraft engines.

HAGAN
HALL
BUROMIN
CALGON

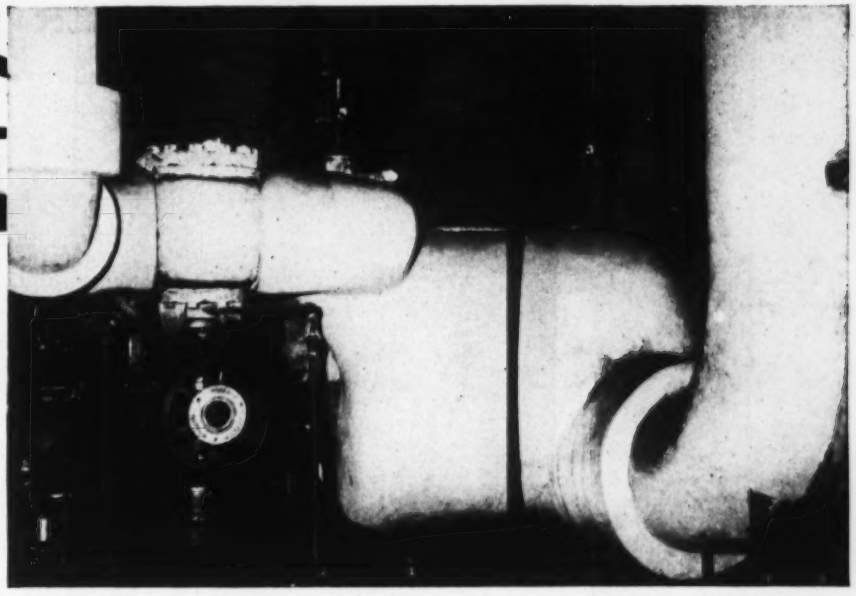
Hagan Corporation

AERONAUTICAL AND SPECIAL PRODUCTS DIVISION
HAGAN BUILDING, PITTSBURGH 30, PA.

CONTROL SYSTEMS FOR AUTOMOTIVE AND AERONAUTICAL TESTING FACILITIES
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
BOILER COMBUSTION CONTROL SYSTEMS



For this new addition to their New York City power plant at East River and 14th Street . . .



(Above) View of recently completed annex to Consolidated Edison's power plant . . . another link in their gigantic expansion program. **(Right)** Close-up of J-M 85% Magnesia Insulation on boiler feed lines. It was expertly installed by the Asbestos Construction Company, Inc., an outstanding J-M Insulation Contractor.

CON EDISON SPECIFIES J-M 85% MAGNESIA PIPE INSULATION FOR MAXIMUM FUEL SAVINGS

Like all materials that went into the new power plant addition of New York's leading gas and electric supplier . . . the pipe insulation had to be the *best*. That's why Consolidated Edison Co. specified J-M 85% Magnesia . . . industry's No. 1 insulation for many decades and *still* the leader in its class.

J-M 85% Magnesia is the leading insulation on the market for temperatures up to 600F. It is bonded with asbestos fibers. This rugged insulation will not distort regardless of the length of time it stays in service. J-M 85% Magnesia fits snug and stays put. Heat savings, therefore, remain constant for the life of the equipment on which this insulation is applied.

For temperatures over 600F, J-M 85% Magnesia is used in combination with Superex*, a J-M insulation for service to 1900F. This double-layer construction, known as Superex Combination, eliminates through joints and protects the jacket against scorching. It also utilizes the higher heat resistance of Superex next to the hot surface, and the greater insulating value of J-M 85% Magnesia for the outer layer.

*Reg. U.S. Pat. Off.

Experience has proved that all insulations must be properly installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced insulation engineers and installation contractors who have made a career of solving complex insulation problems. From coast to coast, these engineers and the contractor's highly skilled mechanics stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings through the years.

When you face your next insulating problem . . . remember that Johns-Manville is "Insulation Headquarters." Consult your near-by J-M Insulation Contractor . . . or write direct to Johns-Manville, Box 60, New York 16, New York. In Canada, write 199 Bay Street, Toronto 1, Ontario.

Skilled Applicators on the team of a J-M Insulation Contractor applying J-M 85% Magnesia to pipelines. Located throughout the nation, these contractors have had years of experience handling all types of installations. They know J-M 85% Magnesia and other J-M insulations as *quality* products, and take pride in applying them properly. Result: an insulation job that pays dividends through the years in maximum fuel savings.

Johns-Manville *FIRST IN* INSULATION

MATERIALS • ENGINEERING • APPLICATION

AMERICA NEEDS YOU
IN THE GROUND OBSERVER CORPS!

© MURAY

HERE'S WHY: The potential of modern military offense is such that a surprise raid against this country could cause tremendous casualties.

Our military defense is aware of this possibility. Air Force interceptor planes and Army anti-aircraft batteries are designed to repel such an attack.

But—if that attack ever comes—*warning must come through in time!* Citizen volunteer plane-spotters—ground observers—play a vital role in providing the necessary warning.

Already some 300,000 civilian Americans are contributing to the job of guarding our ramparts. I salute these Ground Observers for their patience, their perseverance, their patriotism.

But the job calls for twice their number to man these vital posts. Will you serve your country for two hours a week?

Dwight D. Eisenhower

PRESIDENT OF THE UNITED STATES

★

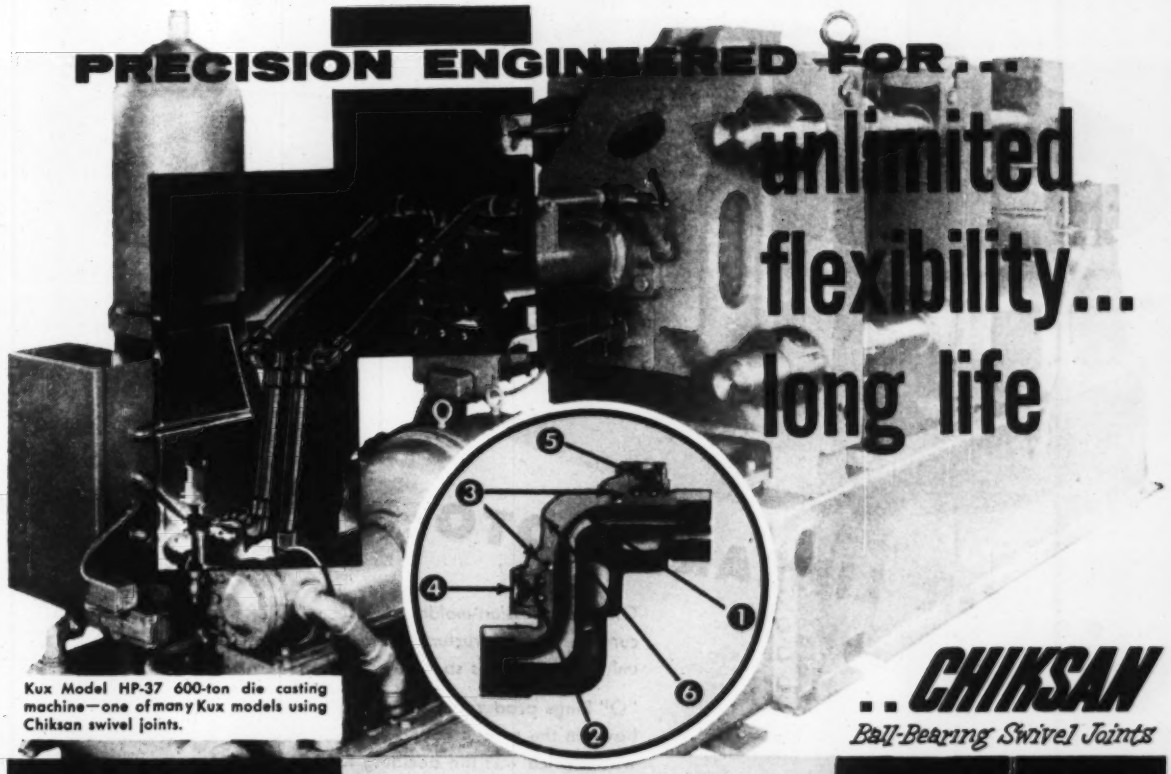
Keep your eye on the sky in the
GROUND OBSERVER CORPS

Call or write your
Civil Defense Director

Wake Up!
Sign Up!
Look Up!

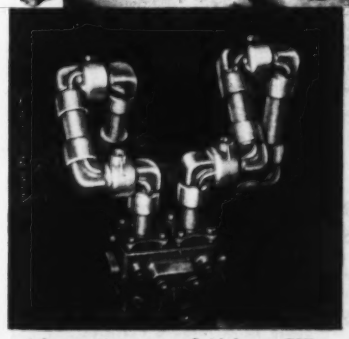
PRECISION ENGINEERED FOR . . .

unlimited flexibility... long life

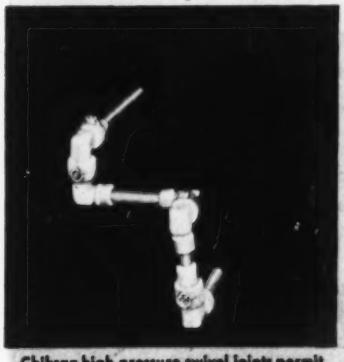


Kux Model HP-37 600-ton die casting machine—one of many Kux models using Chiksan swivel joints.

. . CHIKSAN
Ball-Bearing Swivel Joints



Johnson Motors cut fluid losses 75%—setting-up time 75% with Chiksan joints on their 48 die-casting machines.



Chiksan high-pressure swivel joints permit compact assembly for operation in limited space on injection molding equipment.

1. Smooth flow radii for minimum flow restriction.
2. 2 rows of ball bearings handle thrust and radial loads.
3. Balanced packing units for specific services.
4. Spherical radius ball plug for uninterrupted ball race.
5. Grease retainer provides extra protection for ball race area.
6. Wall thicknesses provide maximum strength throughout.

CHIKSAN Ball Bearing Swivel Joints turn with full 360° rotation in 1, 2, and 3 planes, handling air, hydraulics, fuels, oils, water and other fluids.

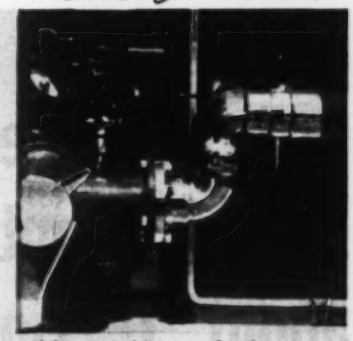
There are over 1,000 different types, styles and sizes for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 75° F. to a plus 500° F. Packing materials have been designed for each specific service.

Wherever unlimited flexibility is required in your research, design and engineering of new equipment for modern industry—CHIKSAN will help you find the solution.

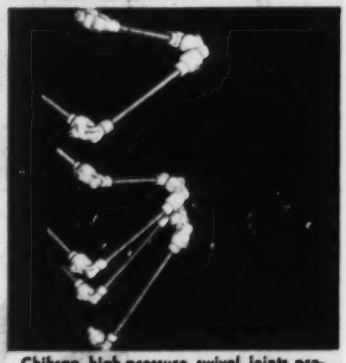
Write for complete information. Dept. 10-ME

The Flow of Enterprise Rides on

CHIKSAN
Ball-Bearing Swivel Joints



Chiksan swivel joints on fire department trucks provide increased hose flexibility and save on hose wear.



Chiksan high-pressure swivel joints provide flexibility and eliminate danger of ruptured steam lines on platen presses.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 3, Illinois • Newark 2, New Jersey

Well Equipment Mfg. Corp., Division: Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif.; Newark 2, N. J. • Chiksan of Canada Ltd., Edmonton, Alta.

COMPRESSION?

INJECTION?

TRANSFER?

. . . OR LINEAR "ROTO-MOLDED"!

Only *compression-molding* produces "O" Rings with the uniform cure and grain structure . . . flash-free finish . . . and precise, uniform tolerances so necessary in modern sealing applications.

"O" Rings produced by injection or transfer methods have, in the past, enjoyed some advantages in applications where price was the deciding factor.

Today this advantage no longer exists!

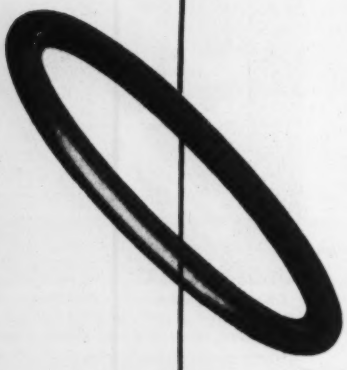
LINEAR, with a revolutionary, new, high-speed process now produces true compression-molded "O" Rings at a rate and cost not possible with injection molding or transfer methods.

This process, known as "ROTO-MOLDING", provides all these superior features—regardless of the compound used:

1. Superior flash-free finish.
2. Far closer dimensions than ever before possible by *any* molding method.
3. Superior physicals.
4. Greater resistance to distortion under hydraulic or pneumatic pressure.
5. Greater resistance to abrasion.

There's no need to compromise with the finest quality, when the finest now costs no more! Get full facts today on LINEAR ROTO-MOLDED perfect circle "O" Rings in a variety of sizes and materials.

Here are the straight facts about "O" rings



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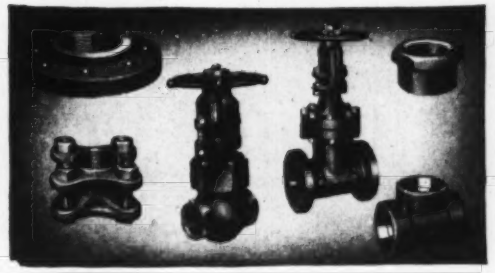
LINEAR

LINEAR Inc STATE ROAD & LEVICK ST. PHILA 35, PA

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

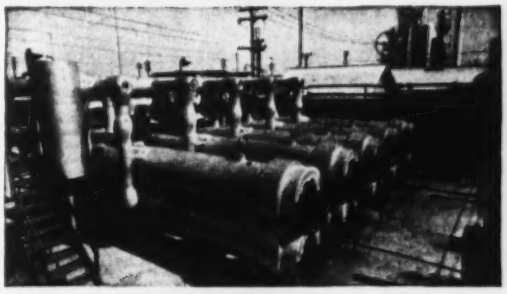
Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

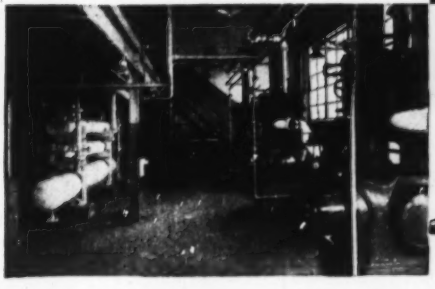
PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.



MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

Vogt

PRODUCTS

FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland St. Louis, Dallas, Charleston, W. Va.

CONTRACTING DIVISION

MIDWEST PIPING COMPANY, Inc.

ST. LOUIS, MISSOURI

JOB No. C-3550

LINE SKETCH.

DATE MAR 4, 1953

NAME WABASH RIVER STATION OWNER PUB. SERV. CO. IND. LOCATION TERRE HAUTE, IND

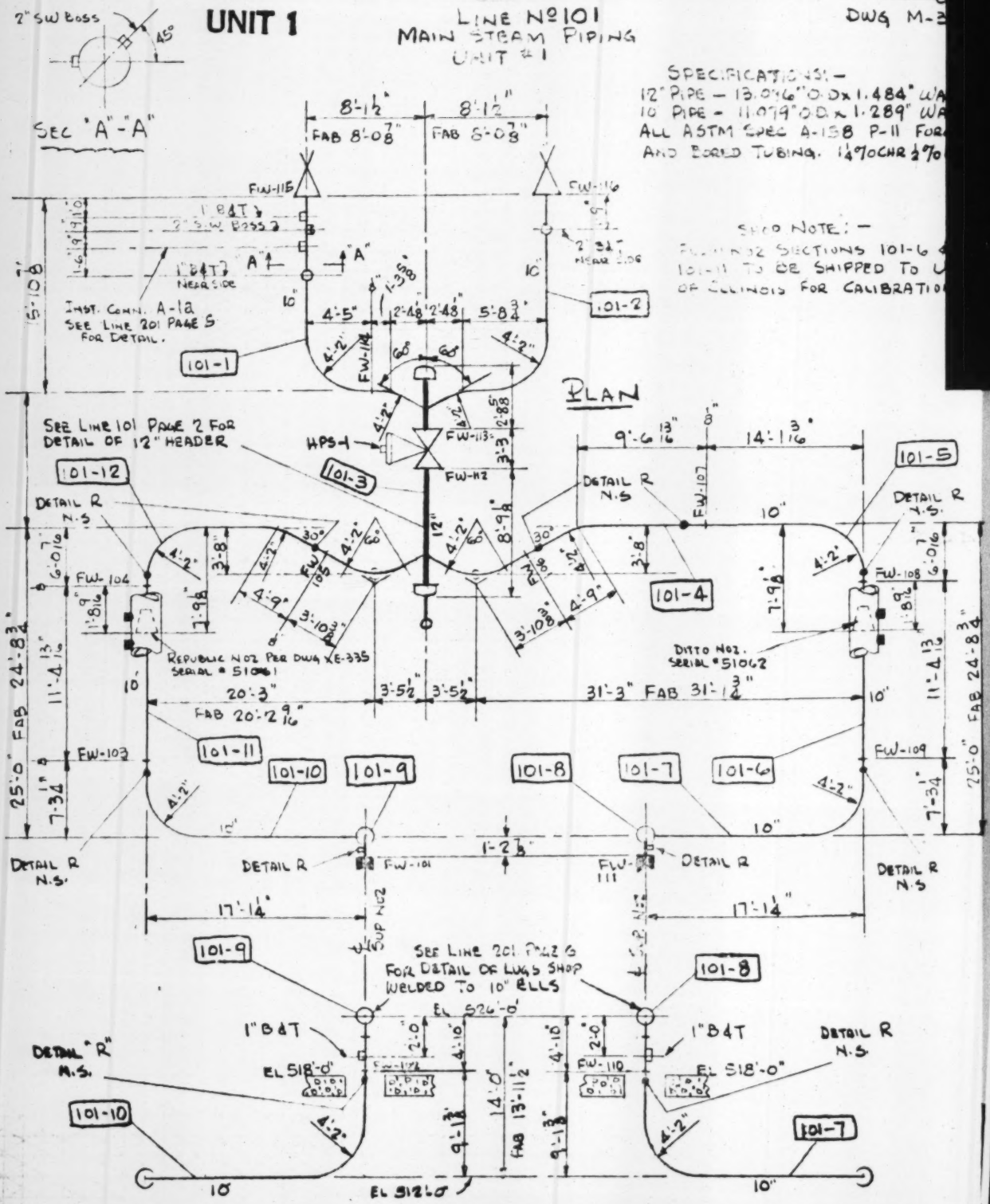
UNIT 1

LINE No 101
MAIN STEAM PIPING
UNIT #1

DWG M-3

SPECIFICATIONS:-
12" PIPE - 13.096" O.D. x 1.484" WA
10" PIPE - 11.079" O.D. x 1.289" WA
ALL ASTM SPEC A-158 P-11 FOR
AND BORED TUBING. 1¼% CHR ½%

SHOP NOTE:-
FLUID NO2 SECTIONS 101-6 &
101-11 TO BE SHIPPED TO U
OF ILLINOIS FOR CALIBRATIO



Form 475 8M 10-51

LINE 101 PAGE 1

Field Erection Sketches like this HAVE Important Advantages to Users of MIDWEST PIPING

Reproduced on the page at left (about ¼ actual size) is a Field Erection Sketch typical of those prepared for all piping installed by our Contracting Division. These sketches have very real advantages for the customer.

These sketches are made by our skilled piping engineers who are thoroughly familiar with both shop fabrication and field erection. Each line is divided into a series of subassemblies that minimize and simplify the field welding . . . the difficult work is done in our well-equipped fabricating shops. Each fabricated subassembly has an individual piece mark number for easy field identification and correct sequence of erection. The fabricated subassemblies are shipped to the job in that order.

All planning has been done by our engineering staff . . . which reduces field thinking and eliminates guesswork. Erection is from these sketches instead of from the design engineer's drawings . . . this speeds up the work and results in a real cost saving and earlier completion of the job.

These Field Erection Sketches provide much essential detail that is never expected of the designer. They serve as a check of the design engineer's drawings and if discrepancies occur they are disclosed before fabrication instead of during erection.

The preparation of these Field Erection Sketches requires careful analysis of the job which often suggests changes that simplify and streamline the piping design and reduce costs in the shop and in the field.

Consequently, the customer gets a better piping job at minimum cost . . . which is why you will find it to your advantage to call in Midwest whenever you have a piping job.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

SALES OFFICES: NEW YORK 7—30 CHURCH ST. • BOSTON 27—426 FIRST ST.
LOS ANGELES 33—520 ANDERSON ST. • CHICAGO 3—79 WEST MONROE ST.
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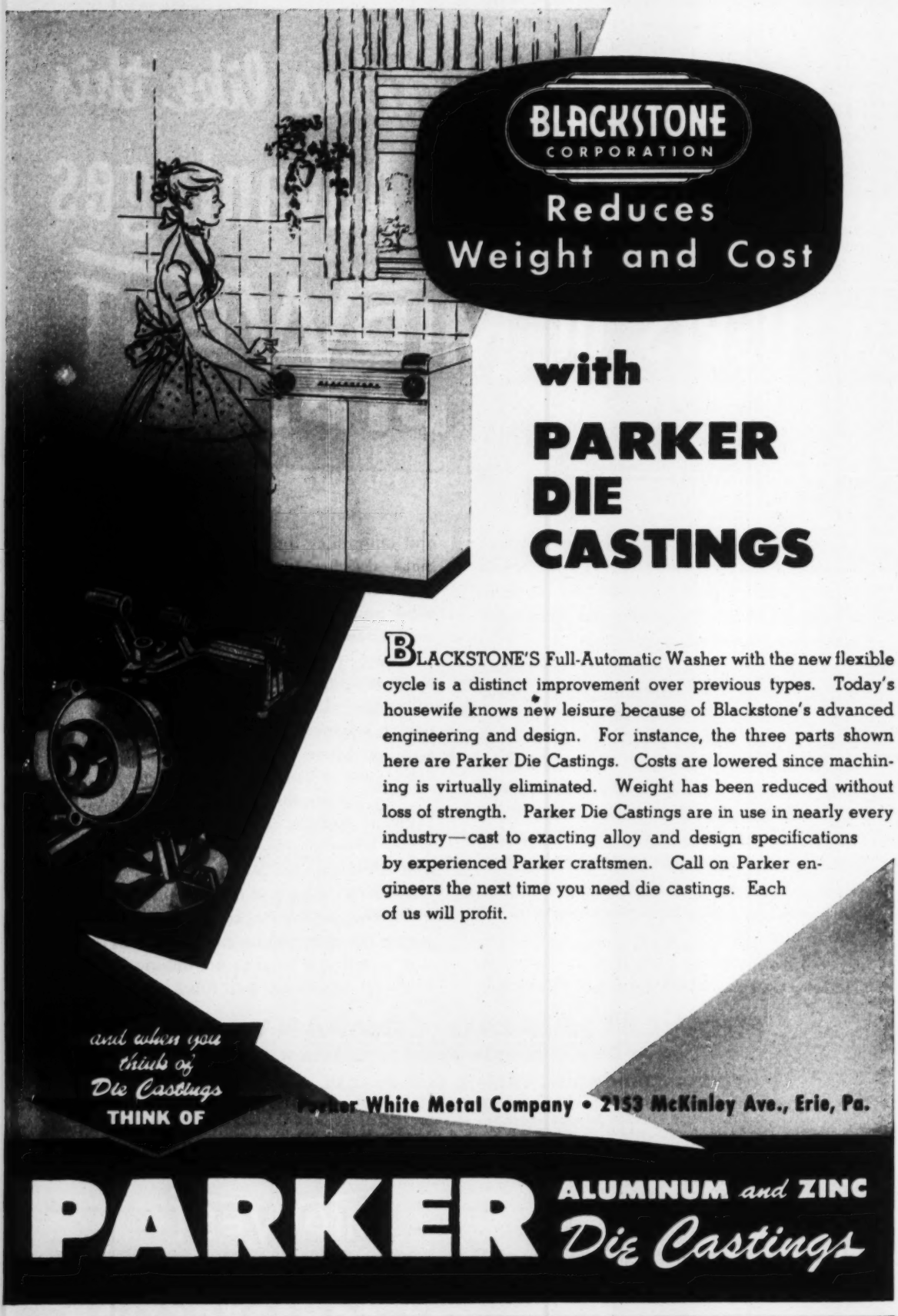
TULSA 3—224 WRIGHT BLDG.

MIDWEST

PIPING FABRICATION and CONSTRUCTION

OFFERS YOU MANY BENEFITS

5497


BLACKSTONE
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Reduces
Weight and Cost
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PARKER
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BLACKSTONE'S Full-Automatic Washer with the new flexible cycle is a distinct improvement over previous types. Today's housewife knows new leisure because of Blackstone's advanced engineering and design. For instance, the three parts shown here are Parker Die Castings. Costs are lowered since machining is virtually eliminated. Weight has been reduced without loss of strength. Parker Die Castings are in use in nearly every industry—cast to exacting alloy and design specifications by experienced Parker craftsmen. Call on Parker engineers the next time you need die castings. Each of us will profit.
and when you think of Die Castings THINK OF
Parker White Metal Company • 2153 McKinley Ave., Erie, Pa.
PARKER
ALUMINUM and ZINC
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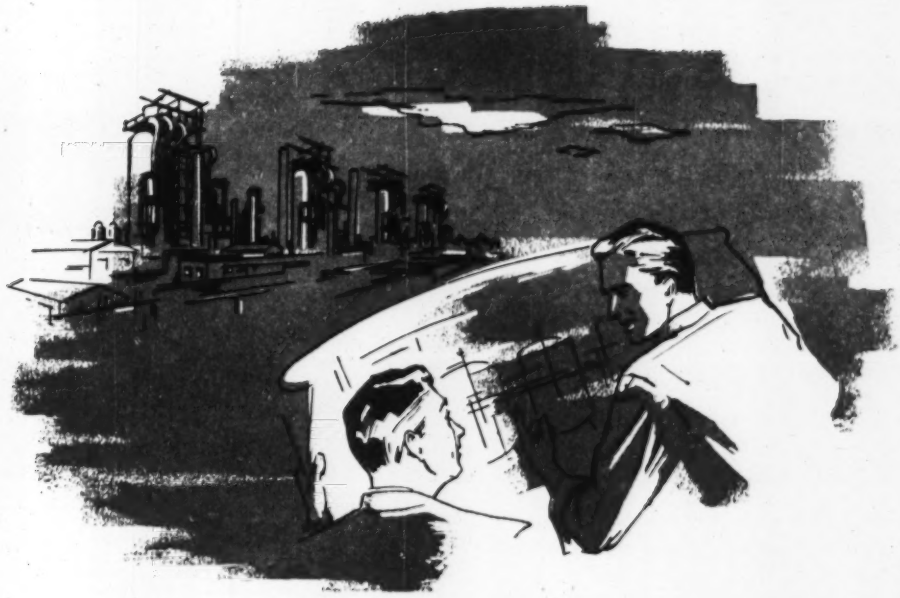
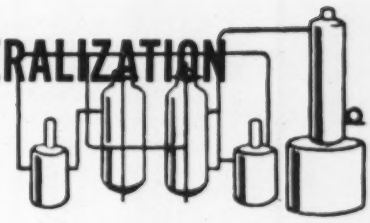


HIGHER WATER PURITY BY DEMINERALIZATION

...A Cochrane Achievement



Long experience with *all* phases of water conditioning problems places Cochrane in the position of leader in the design and application of equipment to meet the exacting requirements of demineralization.

Cochrane Demineralizers now operating on boiler feed and process waters are continuously producing effluents with total dissolved solids and silica residuals approaching zero, within the limits of accuracy of available testing methods. These include 2-bed, 3-bed and 4-bed systems—compact mixed bed units—manually controlled or automatically operated.

Cochrane engineers and manufactures every type of ion exchange precipitation type water conditioning equipment—which assures you of unbiased recommendations for equipment best suited to your requirements. Its complete service provides single responsibility for engineering, fabrication and continued satisfactory operation.

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HOT PROCESS SOFTENER

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Wrap the big hand around the little hand . . . for now begins a little heart's journey into prayer . . . the guide is Dad, the goal is a security not even he can provide.

But the pattern is security, and it is Dad's privilege to supply his part of it for the little hearts in his care.

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The security of our homes is our worthiest goal. And providing it is a privilege unique in a country like ours, where each of us is free to choose his way.

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If you've tried to save and failed, chances are it was because you didn't have a *plan*. Well, here's a savings system that really works—the Payroll Savings Plan for investing in U.S. Savings Bonds. This is all you do. Go to your company's pay office, choose the amount you want to save—a couple of dollars a payday, or as much as you wish. That money will be set aside for you before you even draw your pay. And automatically invested in Series "E" U.S. Savings Bonds which are turned over to you.

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Better because . . . **There's no guesswork when a silver-brazed joint is made with a Walseal fitting. Sil-Fos alloy, which appears as a fillet at the face of a Walseal joint, comes from rings which have been factory-inserted in the end connections of Walseal fittings. The bright silver alloy fillet that you can see assures full penetration of alloy for a permanently leakproof joint.**

Cutaway view of a Walseal Tee showing: factory-inserted ring of silver brazing alloy; fillet of silver brazing alloy that appears upon completion of Walseal joint; cutaway view of the completed joint showing that silver brazing alloy has flowed in both directions from the factory-inserted ring.

Walseal is a registered trade mark which identifies valves and fittings manufactured by the Walworth Company. Walseal products have factory-inserted rings of silver brazing alloy in threadless ports. Walseal joints can be made only with Walseal valves and fittings.

If you're piping water, oil, steam, air, oxygen, nitrogen, helium or other industrial gases or refrigerants through brass, copper, or copper-nickel pipe, you'll want to investigate Walseal — available in complete lines of valves and fittings in four distinct pressure ranges — from 0 to 5000 psi. working pressure*. Your copy of Circular 115 will be sent on request . . . see your near-by Walworth Distributor today, or write to: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

*Walseal fittings and valves are being used at sub-zero temperatures as low as —350 F.

Make it "a one-piece pipeline" with WALSEAL

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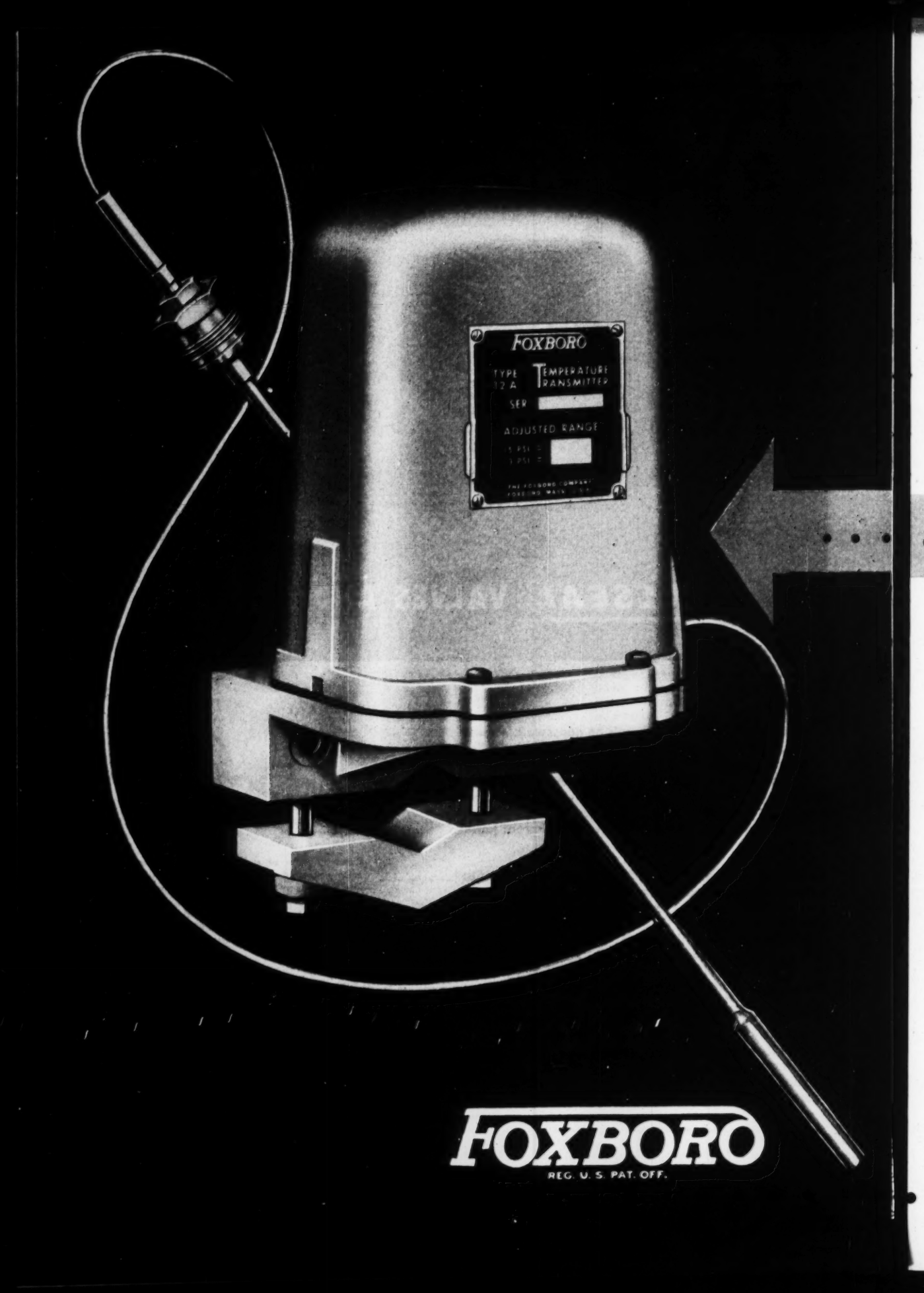
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Rugged, Versatile Temperature Transmitter Improves Remote Control

. . . the Foxboro M/12A (pneumatic)

There is no easier, simpler way to measure remote temperatures, *fast*, over so wide a range, with such high sustained accuracy, and at so low a cost!

Between the limits of —100°F. and +1000°F., with operational spans of 50°, 100°, 200°, and 400°F, this rugged, highly responsive instrument performs outstandingly under the most severe conditions. It is fully compensated for ambient temperatures and pressure, and is insensitive to mechanical vibration.

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With its weatherproof housing and integral mounting bracket, it can be installed in any hazardous, corrosive, or outdoor location. Transmission lines are ¼" O.D. tubing — no troublesome conduit, no costly capillary to run.

Write for Bulletin 13-17. It explains fully why the Foxboro M/12A Temperature Transmitter gives better performance with lower installation and maintenance cost. **The Foxboro Company, 9610 Neponset Ave., Foxboro, Mass., U.S.A.**

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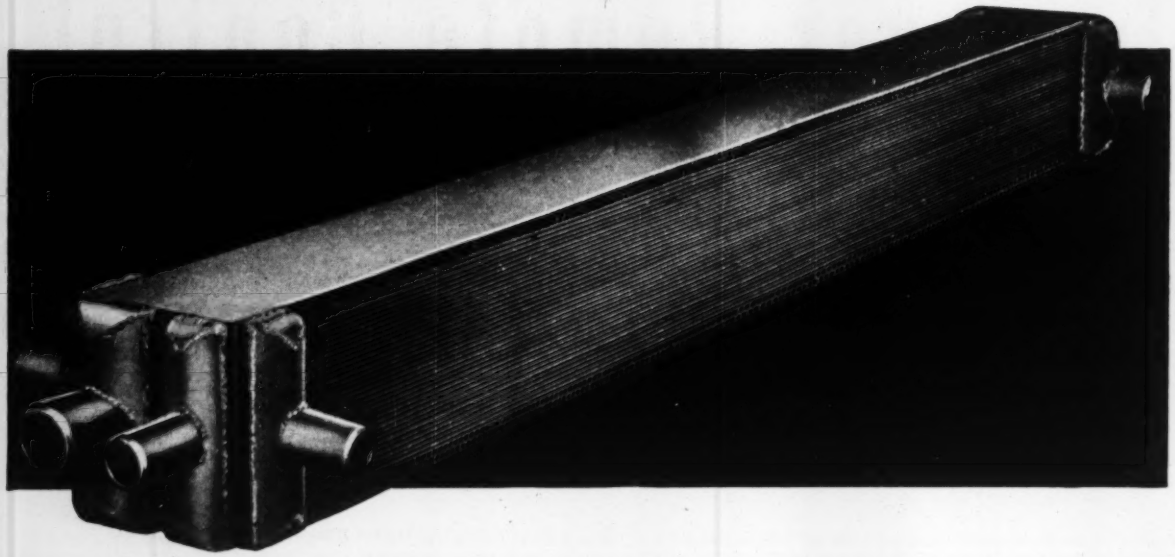
How to take the plus cost out of minus temperatures

even at -350°



In many applications, TRANE Brazed Aluminum Heat Exchangers have licked the problem of excessive cost in low temperature heat transfer. Fabricated entirely of aluminum, they take full advantage of aluminum's higher thermal conductivity, its improved strength and high ductility at low temperatures. This, plus the inherently higher performance characteristics of the TRANE Brazed Aluminum Surface design, produces a heat exchange unit that is lighter, more compact, far more efficient—and far less costly—than conventional equipment.

In many instances, TRANE Brazed Aluminum Heat Exchangers have taken only *one-third* the space, weighed only *one-fourth* as much, as conventional exchangers. Yet, for all their light weight and compactness, these rugged units have the ability to operate at working pressures up to 450 lbs. p.s.i. at lowest temperatures.

Because of their economy, and because of their ability to operate dependably at temperatures as low as −350 degrees and still pack as much as 450 square feet of surface into a single cubic foot of lightweight space, TRANE Brazed Aluminum Surfaces are ideally suited for low temperature applications such as ammonia, oxygen, helium, nitrogen and argon processing.

For that matter, TRANE Brazed Aluminum should be your first consideration for any difficult heat transfer application requiring *close temperature* approaches, *multi-stream* exchange, or *low temperatures*.

If you have a heat transfer problem, now is the time to call in TRANE. Our 30 years' experience in various types of heat transfer, and our engineering facilities, are always at your disposal. And for your files, get your copy of "Extended Surface Heat Transfer Equipment," showing the wide range of design possibilities. Simply contact your nearest TRANE Sales Office or write to TRANE, La Crosse, Wis.

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A complete line — 768 stock sizes of Standard Bearings — 221 stock sizes of Cored Bars — 35 stock sizes of Solid Bars. CERTIFIED Highest Quality, with a MONEY-BACK offer.

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SPROCKETS Larger, heavy duty SHOLD-A-GRIP Interchangeable Tapered Sprockets and Bushings

Sprockets up to 24" pitch dia. — and Bushings to fit shaft sizes from ½" to 3" by 16ths. Also, more sizes available in conventional sprockets.

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A sturdy metal kit, with 47 common sizes of Bost-Bronz oil-impregnated bearings, from which 313 standard sizes can be cut with a hacksaw — means you have any bearing you need on *hand* in any emergency. Saves 50% over buying same bearings separately.

20 SHAFT SIZES UP TO 2 7/16"

NEW

PILLOW BLOCKS and Flanged Cartridges in larger sizes

ADDED TO FORMER ½" TO 1¼" RANGE

Now, precision Type ABEC No. 1 Classification Bearings in a stock size range for 27 shaft sizes from ½" to 2 7/16", fully self-aligning.

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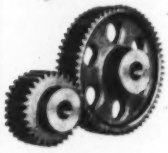
20° PRESSURE ANGLE SPUR GEARS in a full range of stock sizes



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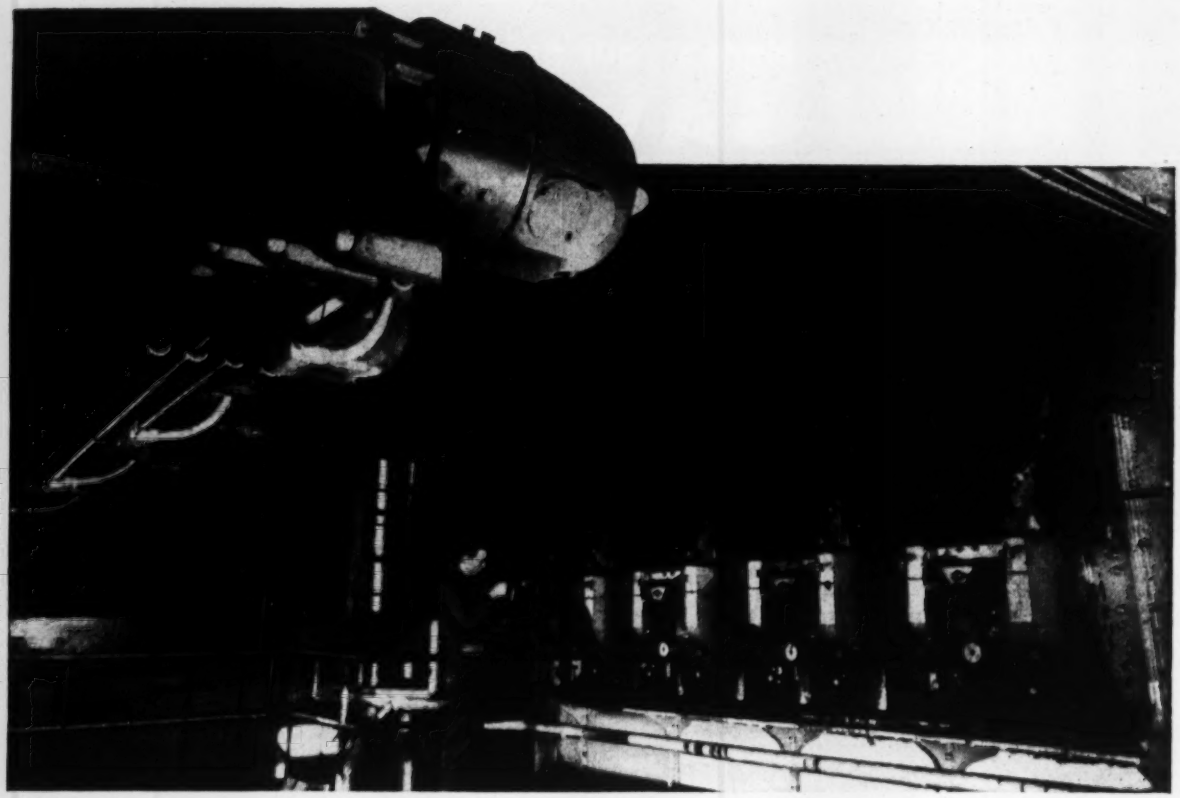


Drive mounting problems erased with Westinghouse *Life-Line** Gearmotors

Putting the best drive in the minimum space is a problem constantly facing design engineers. In answer to this problem, Westinghouse Life-Line Gearmotors provide unit compactness, rugged construction and job-proved efficiency.

Westinghouse Life-Line Gearmotors have both motor and gears designed as an integral unit. As a result, there's a major saving in space because all belts, chains and pulleys can be eliminated. This means no alignment problems. Since integral design lessens the number of wearing parts, over-all maintenance is cut to a minimum.

With split-case gearmotors, there's no need to allow large work areas for removal or dismantling—all servicing can be done with the gearmotor "on the job". Split-case construction permits the gear cover to be removed in minutes and makes all working parts readily accessible. Any servicing, therefore, becomes a simple, speedy operation.

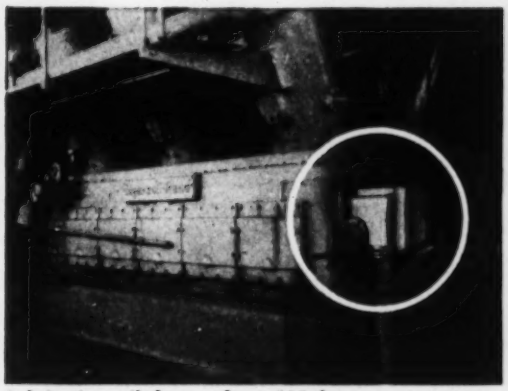
Taper-hardened gear teeth, thorough lubrication and industry-tested Life-Line Motors are but a few of the features which assure long, dependable performance from Westinghouse Gearmotors.

Your local Westinghouse Representative will gladly furnish you with additional information. Call him at any time or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. *Trade-Mark J-07322

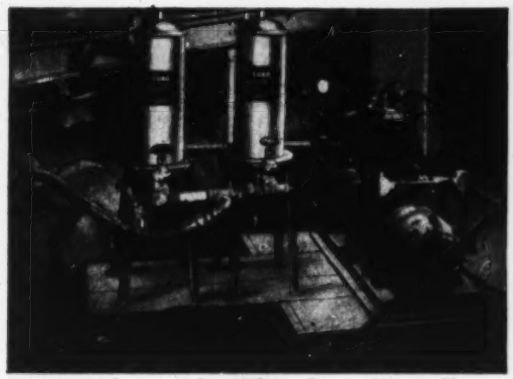
YOU CAN BE SURE...IF IT'S Westinghouse

See how Cuno handles any filtration problem

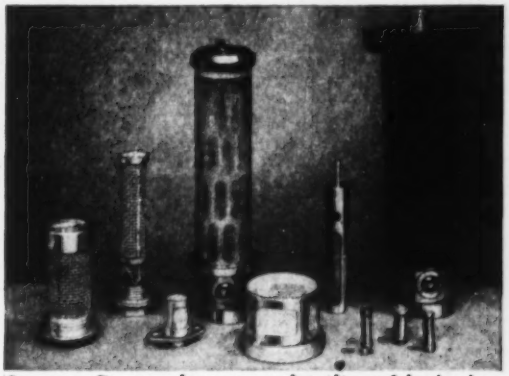
10,000 gallons of water per minute are filtered by six of these Cuno FLO-KLEAN filters, used to remove sand and gravel from incoming well water at pharmaceutical plant. Plant records show that the FLO-KLEANS, by protecting valves and pumps from wear caused by sand, are responsible for saving up to $2000 per month in maintenance costs.



Lubricating oil for modern 600 hp gas compressor is thoroughly strained by four Cuno AUTO-KLEAN filters. The continuously cleanable all-metal AUTO-KLEANS are specified as standard equipment by leading manufacturers of Diesel engines, compressors, pumps, machine tools and other heavy-duty machinery.



Paints and enamels. This Cuno MICRO-KLEAN installation filters enamel being pumped from storage tanks to shipping containers. This micronic media provides finer filtration at lower costs for chemicals, oils, gases, water and many other liquids. Records show that the MICRO-KLEAN element lasts twice as long as ordinary cartridges.



Screens. Cuno makes a complete line of both electrolytically formed and woven screen strainers designed to be built into your product. The electrolytically formed screens are available in nickel; the woven screens of steel, brass, copper, stainless and other alloys are provided in all standard variations of weave.

• We're really proud of our growing list of satisfied customers, like Buda, Bullard, Consolidated Paper, Du Pont, Ingersoll-Rand, Pratt & Whitney, Sherwin-Williams and others who use Cuno filters for anything from acids to tar. They know that if it can be pumped, Cuno can filter it.

We'd like to know about your filtration problem, too. Write for free analysis questionnaire. Cuno Engineering Corporation, Dept. 654, Meriden, Conn.

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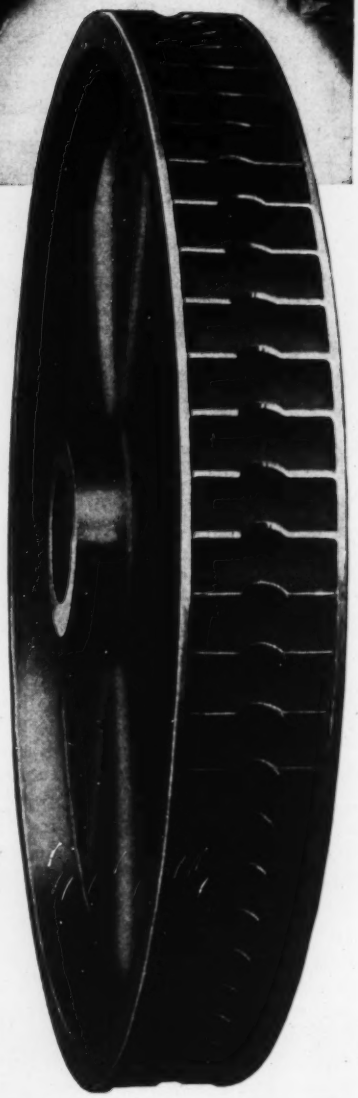
ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

Two Terry Turbines equipped with "trouble eliminators"



Because these turbines have solid wheels, they can take a lot of abuse, without complaint. Here's why:

1. The wheel has no separate parts to become loose or work out. It is a single forging, in which a series of semi-circular buckets is milled.

2. Blade wear is of little consequence because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Wear does not materially affect horsepower or efficiency.

3. The blades cannot foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets in a direction at right angles to the shaft.

For complete details of these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

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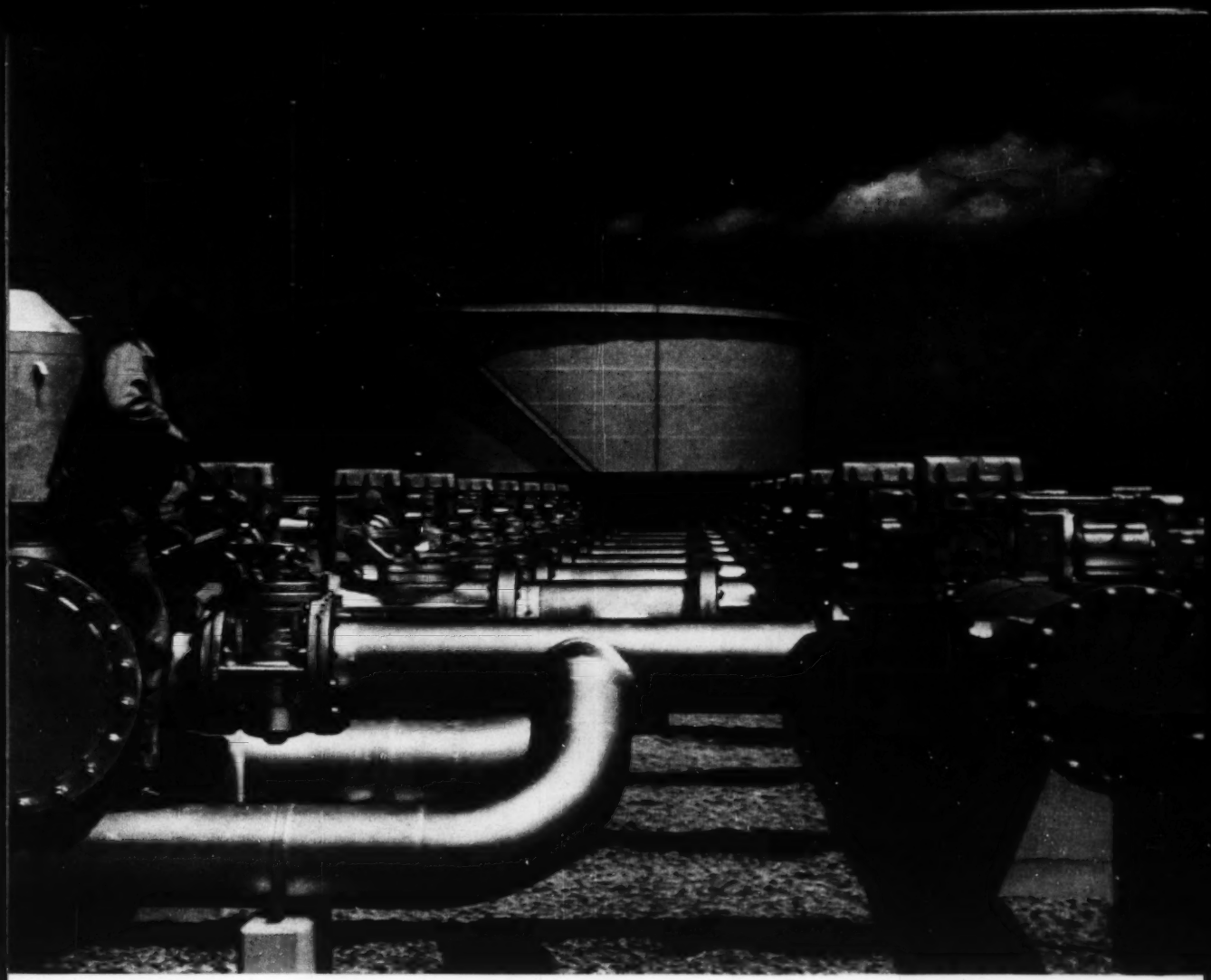

PICTURE OF MAINTENANCE COSTS BEING LOWERED

Every plant that keeps complete records comes to the same conclusion—periodic valve lubrication *saves* money; it's valve failure and replacement that sends maintenance costs skyward.

That is the basic fact behind the Rockwell-Nordstrom valve design, for the internal lubrication system eliminates most reasons for valve failure—Rockwell-Nordstrom lubricant *prevents* galling, jamming, abrasive wear, and seepage.

Systematic lubrication of Rockwell-Nordstrom valves with the right Rockwell-Nordstrom lubricants inevitably leads to lower operating costs. There is no substitute for Rockwell experience—use it to save money on valves. *Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.*

THREE WAYS
THE NORDSTROM LUBRICANT WORKS

1. Lubricant surrounds each valve port with a vapor tight pressurized seal. **Nordstrom valves stay tight.**
2. Lubricant acts as hydraulic jack—a fast quarter-turn to open or close. **Nordstrom valves operate quickly.**
3. Lubricant coats the plug for sliding action—no wear-producing wedging. **Nordstrom valves operate easily.**

Rockwell Built

NORDSTROM VALVES

Lubricant Sealed for Positive Shut Off

WHICH PRODUCT IS EASIEST TO MAKE?

Every manufacturing process has its own special problems. There's no fair way to compare the difficulties of processing paint and paper, or of synthetic rubber and synthetic textiles, for instance.

In every process industry, too, there are special problems of flow control, and no matter what claims you read, there is no such thing as an all-purpose valve.

Undoubtedly, Rockwell-Nordstrom valves approach that point more closely than others because they use the Nordstrom-originated principle of internal lubrication. Rockwell-Nordstrom lubricants seal tightly in gas, liquid or slurry service, and at the same time make operation easy, and eliminate galling or seizing.

Further, Rockwell-Nordstrom makes the widest range of sizes, pressure classes, metals and lubricants, so that for any process, you're wise to check first with *Rockwell Manufacturing Company*, *Pittsburgh 8, Pennsylvania.*

Nordstrom Valves

Another Quality ROCKWELL Product

Heat Recovery is Dollar Recovery. Whether you use it to generate steam . . . or dissipate it up the stack — every BTU you generate costs you money. That's why, even on boilers with capacities as low as 25,000 pounds of steam per hour, it is most often economically right to do something about the waste heat. With the new *Packaged Ljungstrom Air Preheater*, you can apply to your small boilers the principles of heat recovery used by large utilities, where fuel efficiency is sought in every way possible. The Packaged Ljungstrom Air Preheater is a *continuous regenerative counterflow* unit. That is it transfers heat continuously from exit gas to incoming air streams by exposing heating surfaces on a slowly revolving rotor, alternately to both streams. It is highly efficient . . . low in cost . . . and fully reliable.

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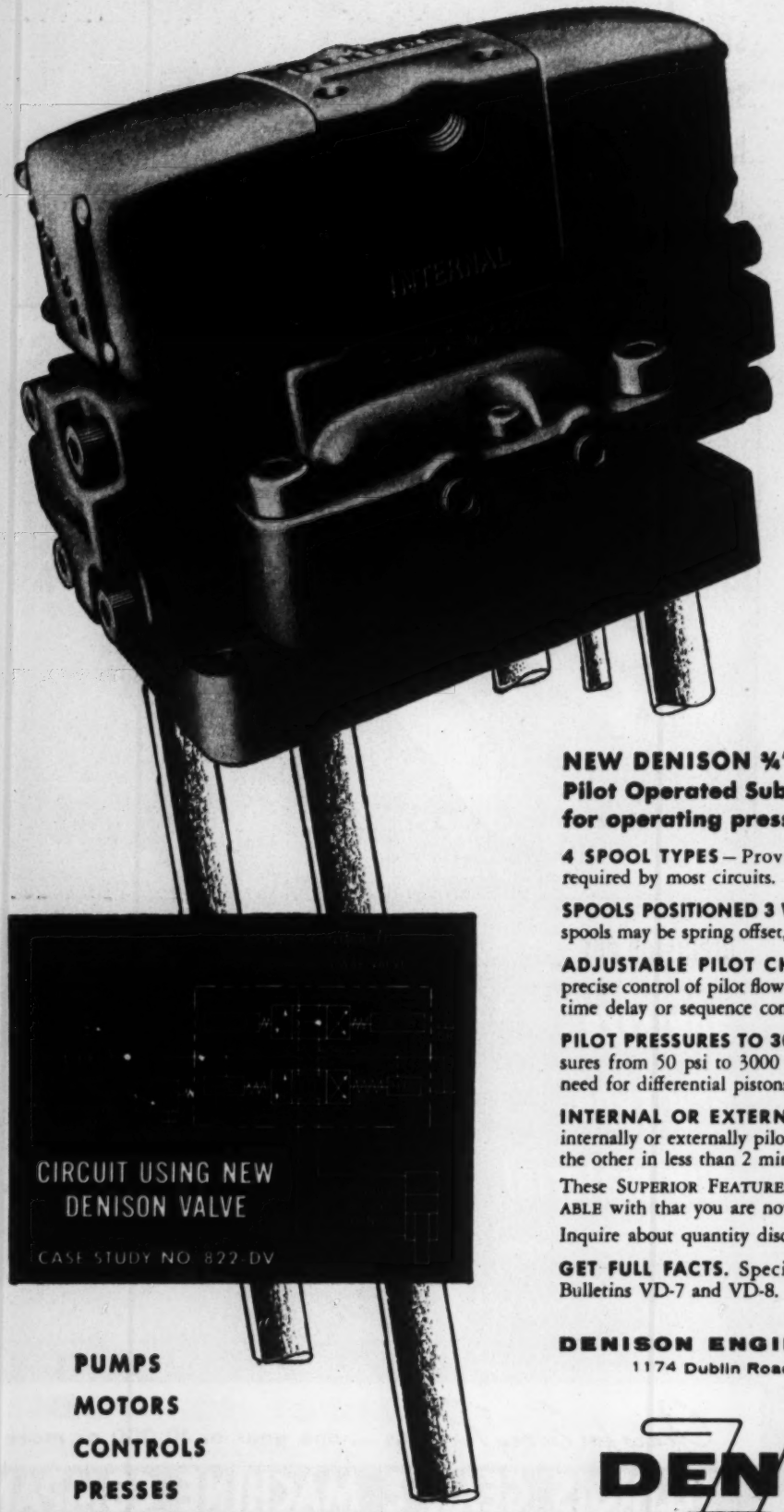

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NEW DENISON ¾" Solenoid Controlled—Pilot Operated Subplate Type 4-Way Valve for operating pressures up to 3000 psi

4 SPOOL TYPES—Provide all positioning arrangements required by most circuits.

SPOOLS POSITIONED 3 WAYS—With solenoid de-energized, spools may be spring offset, spring centered or without springs.

ADJUSTABLE PILOT CHOKES—Available if required for precise control of pilot flow to insure smooth, shockless reversal, time delay or sequence control.

PILOT PRESSURES TO 3000 PSI—Operated with pilot pressures from 50 psi to 3000 psi internally or externally without need for differential pistons.

INTERNAL OR EXTERNAL PILOT PRESSURE—May be internally or externally pilot operated and changed from one to the other in less than 2 minutes.

These SUPERIOR FEATURES in a valve likely INTERCHANGEABLE with that you are now using . . . but at a LOWER COST.

Inquire about quantity discounts.

GET FULL FACTS. Specifications and description are in Bulletins VD-7 and VD-8.

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1174 Dublin Road • Columbus 16, Ohio

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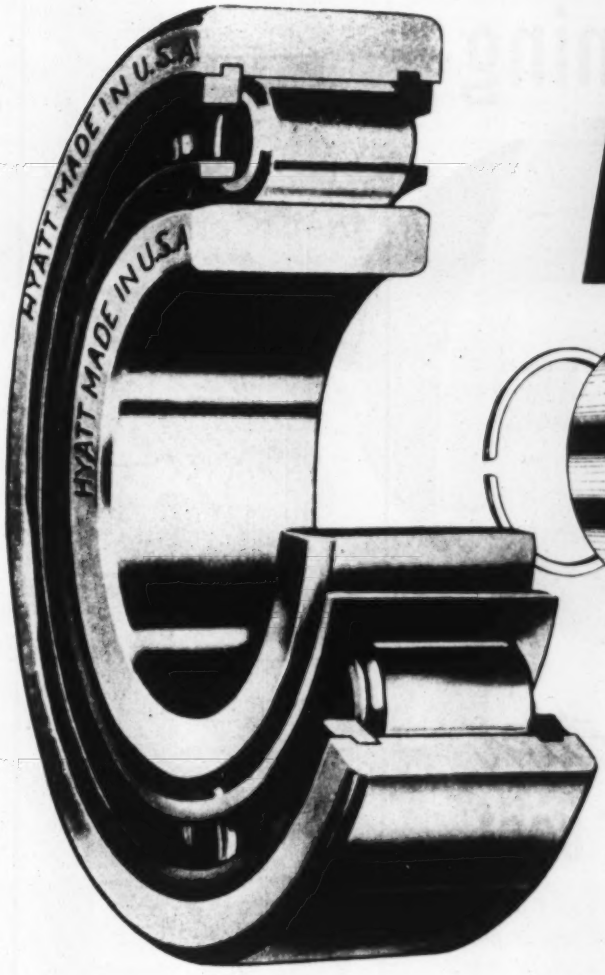
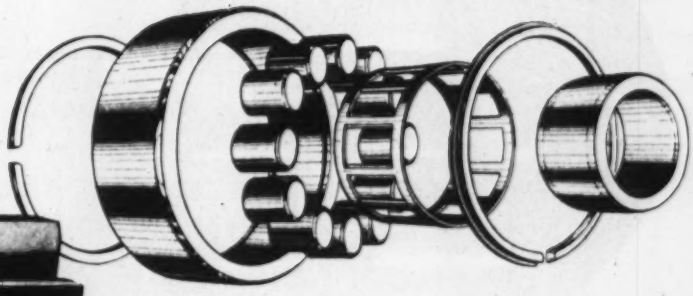


A-TS



one of many Hyatt bearings offering capacity– separability– long life

The Hyatt A-TS Bearing is one of five basic Hy-Load types featuring a separable inner race.

Like all Hy-Loads, the A-TS is built with cylindrical rollers, so that it offers highest capacity for radial loads, plus the long, troublefree service assured by Hyatt's precision manufacture. But beyond that, this particular Hy-Load type offers the design advantages of interchangeable separable components.

With inner races removed, bearings of this type may be applied with rollers operating directly upon the surface of a suitably hardened shaft. This permits the use of larger-diameter shafts or smaller-size bearings, resulting in greater shaft rigidity or a saving in the cost of the bearing.

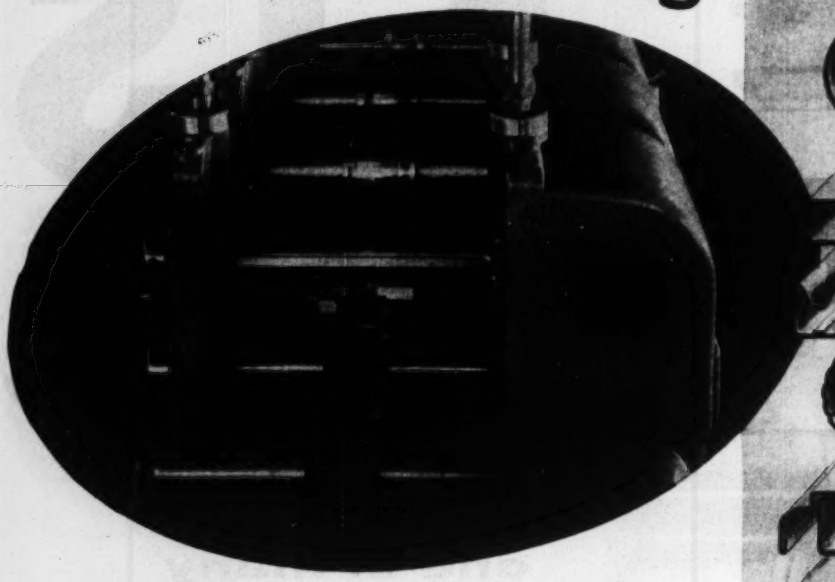
If you aren't already profiting through the use of Hyatt Hy-Load Bearings, contact a Hyatt sales-engineer or write today for our Catalog No. 150.

HYATT ROLLER BEARINGS

STRAIGHT ◯ BARREL ◯ TAPER ◯

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, NEW JERSEY

Cold-Roll-Forming



for *higher production,* at greatly reduced cost

If you make anything that can be cold-roll-formed in fair quantities, you may be sure it will mean either higher production or greatly reduced cost, or both. Moreover, because roll-formed shapes can be designed for highest strength-weight ratio, this method often affords material savings exceeding the entire conversion cost.

There may be some operation in your plant where cold-roll-forming would prove more economical than present methods; or you may be buying components made by other methods, which you could make yourself at greatly reduced cost. Sometimes other operations, such as curving, coiling, embossing, perforating, welding, etc., can be combined with roll-forming at little or no extra cost. In any case, feel free to consult Yoder engineers as to practicability and cost of applying a cold-roll-forming machine to any operations you have in mind.

The Yoder Book on Cold-Roll-Forming may prove of interest to you. It's yours for the asking.

THE YODER COMPANY • 5549 Walworth Ave. • Cleveland 2, Ohio

Complete Production Lines

- **COLD-ROLL-FORMING** and auxiliary machinery
- GANG SLITTING LINES for Coils and Sheets

ENGINEERING YODER MANUFACTURING

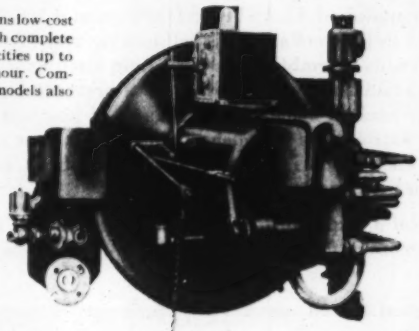
Is inefficient firing stealing dollars from your pocket?

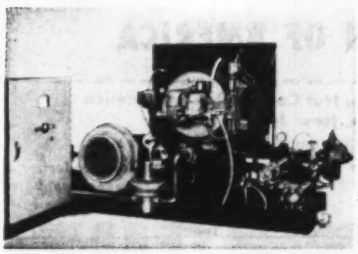
install a

PETRO INDUSTRIAL OIL BURNER

and save 3 ways

Rotary type. Burns low-cost heavy fuel oil with complete reliability. Capacities up to 200 gallons per hour. Combination oil-gas models also available.





Petro "Packaged Unit" (for oil or gas or both). A complete combustion system in which all elements are correctly balanced and integrated. Simply bolt to boiler front and make service connections and it's ready to go.

Send for free catalog today . . .

1. Fire low-cost oils

Petro fires the heavy fuel oils (Nos. 5 and 6) which average 8% richer in heat value than the light burner oils, and cost less per gallon.

2. Save fuel and labor

They efficiently fire heavy oils with complete dependability, following load changes automatically. This makes fuel go farther and saves labor.

3. Low maintenance cost

They are sturdily built and thoroughly reliable. This means low maintenance costs.

There's a Petro burner to fit almost every boiler, in sizes from 11 to 200 gallons per hour.

Heating contractors everywhere recommend and install Petro oil equipment. For illustrated catalog write Petro, 3040 West 106th Street, Cleveland 11, Ohio.

In Canada, write 2231 Bloor Street West, Toronto, Ontario.

Residential Oil and Gas Burners, Oil and Gas Furnaces and Boilers, Industrial and Commercial Oil, Gas and Oil-Gas Combination Burners

PETRO

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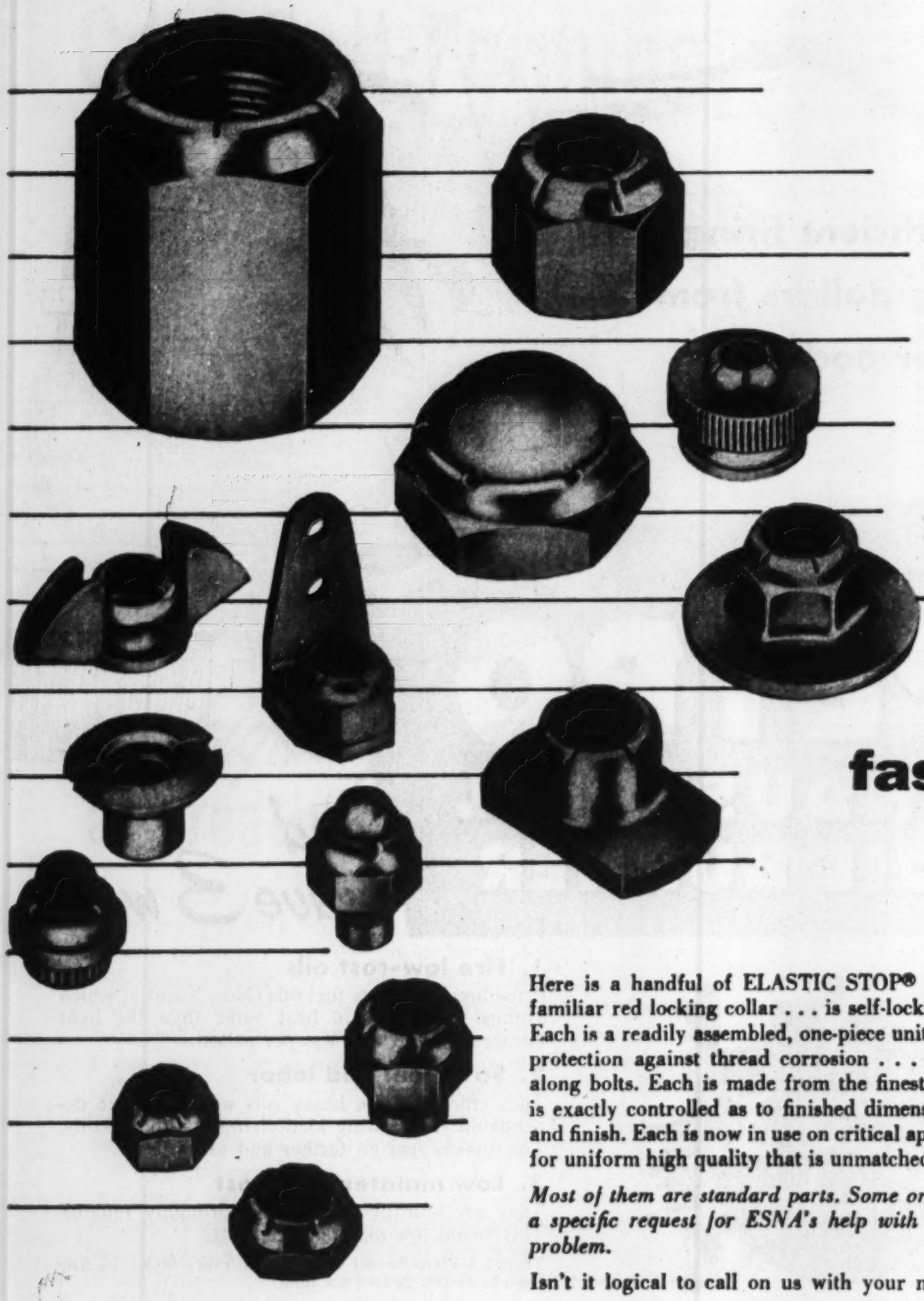
OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT



What shape is a quality fastener?

Here is a handful of ELASTIC STOP® nuts. Each has ESNA's familiar red locking collar . . . is self-locking and vibration-proof. Each is a readily assembled, one-piece unit. Each provides positive protection against thread corrosion . . . prevents liquid seepage along bolts. Each is made from the finest of raw materials. Each is exactly controlled as to finished dimensions, class of thread fit and finish. Each is now in use on critical applications, with a record for uniform high quality that is unmatched.

Most of them are standard parts. Some originated as the result of a specific request for ESNA's help with an important fastening problem.

Isn't it logical to call on us with your next fastening problem?

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ESNA

ROLL-PIN TRADEMARK

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Please send the following free fastening information:

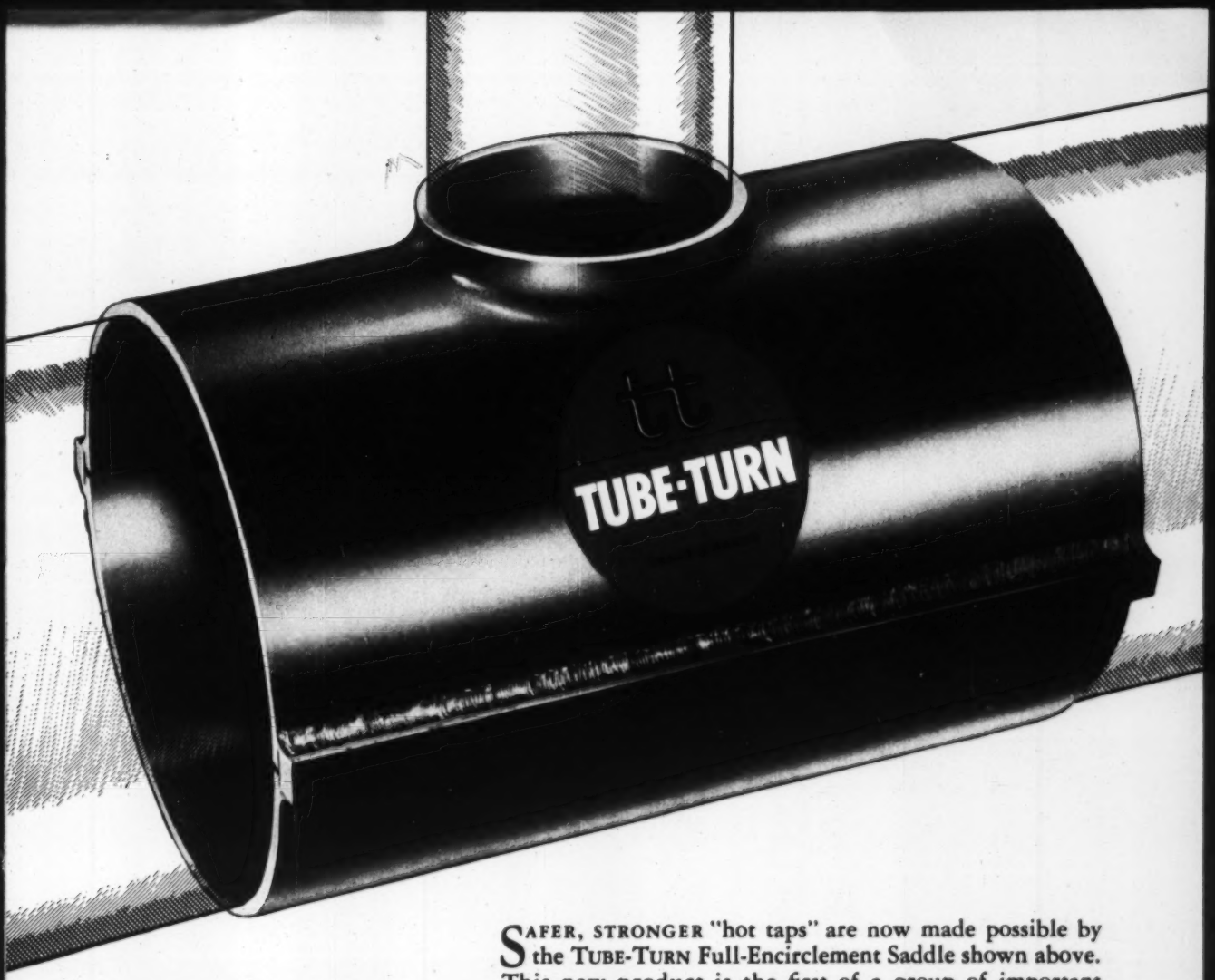
☐ ELASTIC STOP nut bulletin ☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone_____ State_____



NEW!

TUBE-TURN Full-Encirclement Saddle improves "hot-tapping" of piping

SAFER, STRONGER "hot taps" are now made possible by the TUBE-TURN Full-Encirclement Saddle shown above. This new product is the first of a group of important developments of Tube Turns' unique pulsation pressure testing program.

Split longitudinally on a horizontal plane, perpendicular to the axis of the outlet, this new "hot tapping" reinforcement eliminates welds in the critical crotch area. Its installation requires a minimum amount of field welding. When used with high yield strength pipe, no welds are required between saddle and line pipe.

The TUBE-TURN Full-Encirclement Saddle is designed for high yield strength thin-wall pipe and for heavy wall cylinders used for headers, bottles and pulsation dampeners. It can be supplied for pipe sizes through 42", any outlet size, in composition and wall thickness to match service conditions.

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A Division of National Cylinder Gas Company

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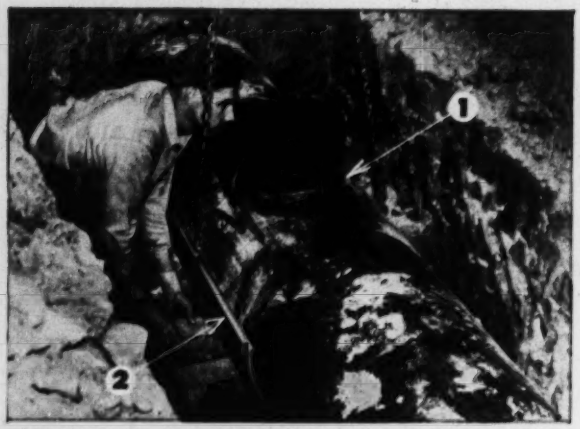
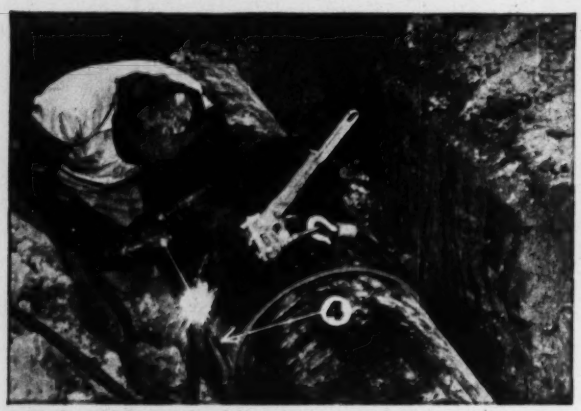
"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

How to install the new TUBE-TURN Full-Encirclement Saddle for a "Hot Tap"

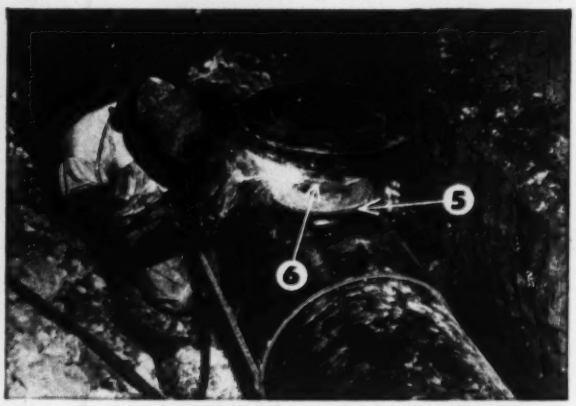


1. Weld branch outlet pipe to run pipe according to normal procedure.
2. Position and block up bottom half of full-encirclement saddle.

3. Slip top half of full-encirclement saddle over branch outlet. Bring two halves together tightly by means of clamp such as shown.



4. Tack weld longitudinal lap plates to top half of saddle, remove clamp and complete welding of plates. (Plates are shop-welded to bottom half).



5. Fillet weld saddle outlet to branch pipe. 6. Join branch pipe to TUBE-TURN Welding Neck Flange. Normal tapping procedure follows.

NOTE THAT when used with high yield strength, thin-wall pipe, as shown above, circumferential welds between saddle ends and run pipe are not required. This precludes possibility of failure due to underbead cracking or to local stress concentrations which exists at such attachment welds with conventional saddles or other types of "hot tap" fittings which must be fillet welded to high yield strength, thin-wall pipe. The TUBE-TURN Full-Encirclement Saddle fully meets all requirements for reinforcement of welded branch connections as developed by Section 8 of the Code for Pressure Piping.

This new, advanced design is another example of TUBE TURNS' pioneering... why it pays to do business with the leader.

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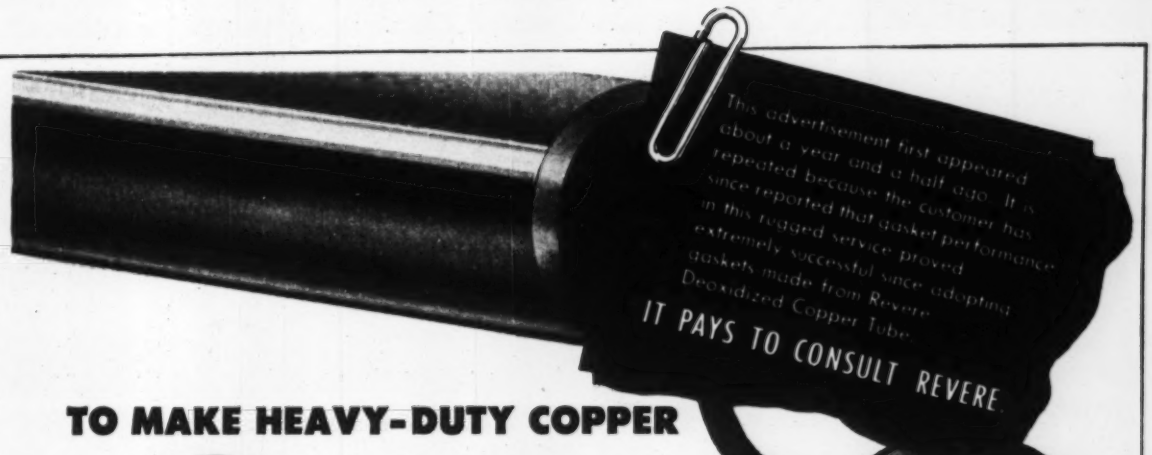
TUBE-TURN

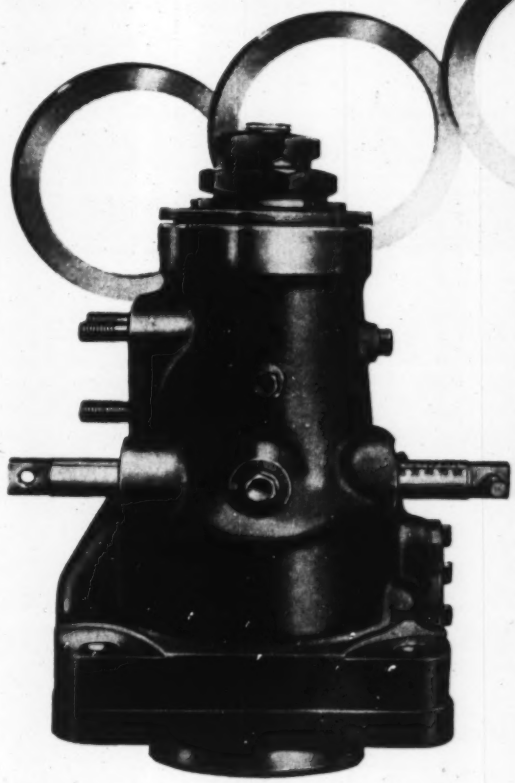

This advertisement first appeared about a year and a half ago. It is repeated because the customer has since reported that gasket performance in this rugged service proved extremely successful since adopting gaskets made from Revere Deoxidized Copper Tube.
IT PAYS TO CONSULT REVERE

TO MAKE HEAVY-DUTY COPPER

Gaskets

USE REVERE DEOXIDIZED

Tube!



Diesel Fuel Injection Pump, made by American Bosch Corp., Springfield, Mass., and gaskets made by cutting rings off 2" deoxidized copper tube.

• An important extra service rendered by Revere consists of collaboration in setting up specifications. This is valuable because there are many different Revere Metals, each with special characteristics. No one copper, for example, will serve to best advantage in every application. A case in point is the matter of copper gaskets for Diesel fuel injection pumps. Copper is of course an ideal metal for gaskets, and is widely used for that purpose. But for this special application, which copper and in what form? The pump is used on large engines for municipal generating plants. It weighs 186 pounds, and must produce the high pressure required to inject fuel near the top of the Diesel compression stroke. Naturally, the load is a pulsating one. American Bosch Corporation came to Revere with the problem. Our suggestion was that much scrap could be saved if the gaskets were made by cutting rings off copper tube, instead of stamping them from strip. This achieved a double purpose, since the tube is made of deoxidized copper, which is superior in this application to electrolytic. We are able to report that these recommendations proved successful. . . . This work was done by the Revere Technical Advisory Service. To get in touch with it, see the nearest Revere Sales Office.

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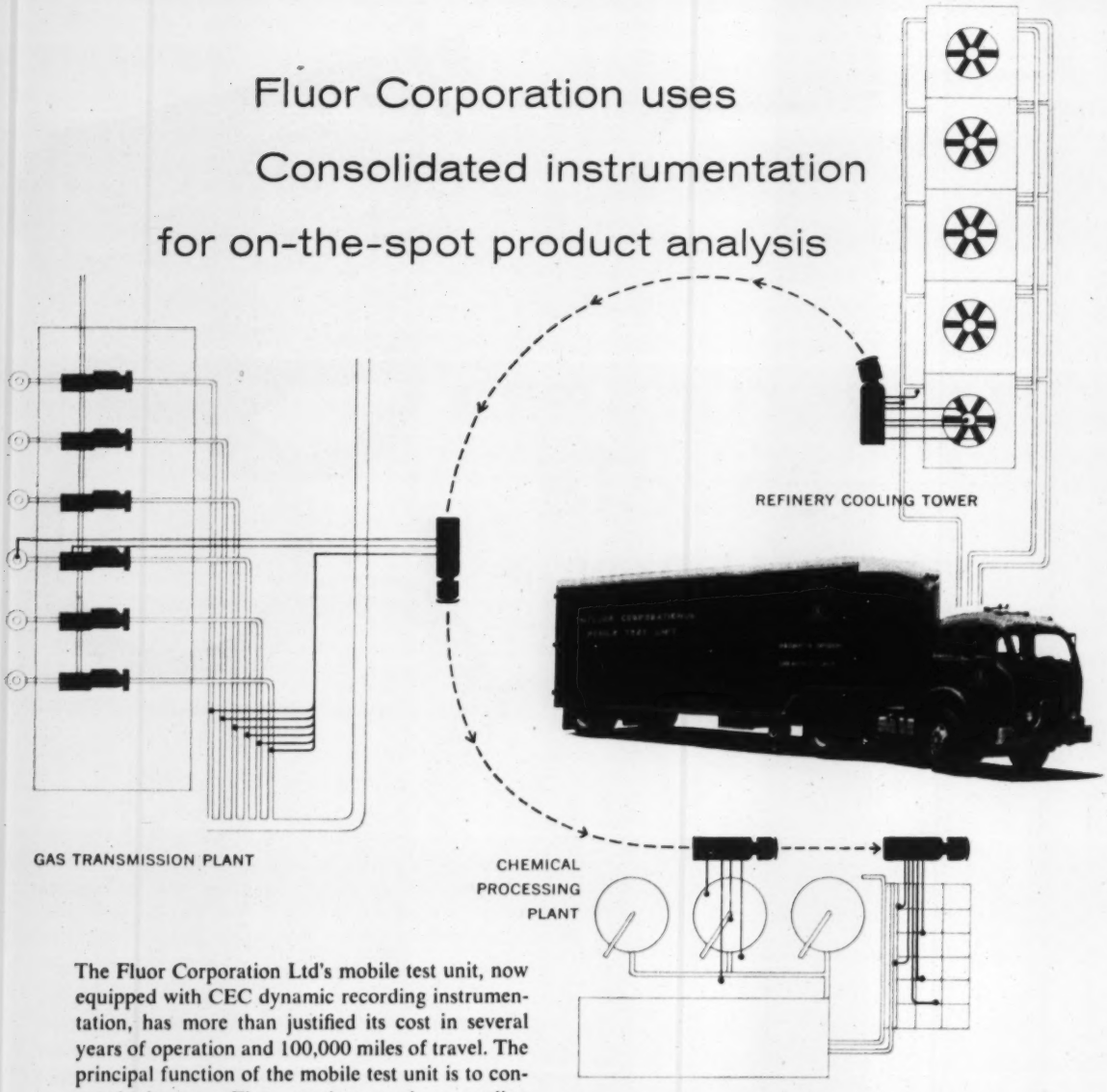
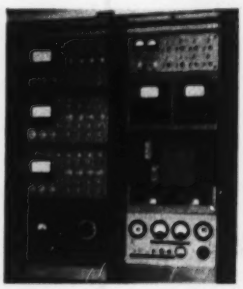
Fluor Corporation uses Consolidated instrumentation for on-the-spot product analysis



The Fluor Corporation Ltd's mobile test unit, now equipped with CEC dynamic recording instrumentation, has more than justified its cost in several years of operation and 100,000 miles of travel. The principal function of the mobile test unit is to constantly improve Fluor products such as cooling towers, pulsation dampeners and fin fan air-cooled heat exchangers by on-the-spot dynamic testing under actual operating conditions. Using a 14-channel Consolidated Recording Oscillograph, Carrier Amplifiers, Transducers and associated CEC equipment, the mobile unit can measure and permanently record every physical phenomenon encountered in the operation of Fluor's products for the petroleum and petro-chemical industries. The attractive mobile unit in its specially built van trailer serves other purposes aiding the solution of field engineering problems and conducting basic research.



Consolidated dynamic recording equipment: recording oscillograph, vibration meters, bridge balance and carrier amplifiers, are rack-and-panel mounted in Fluor's mobile research laboratory.

Free Catalog. *Write for illustrated brochure "Data Processing Instruments." Ask for Bulletin 1301-X4.*

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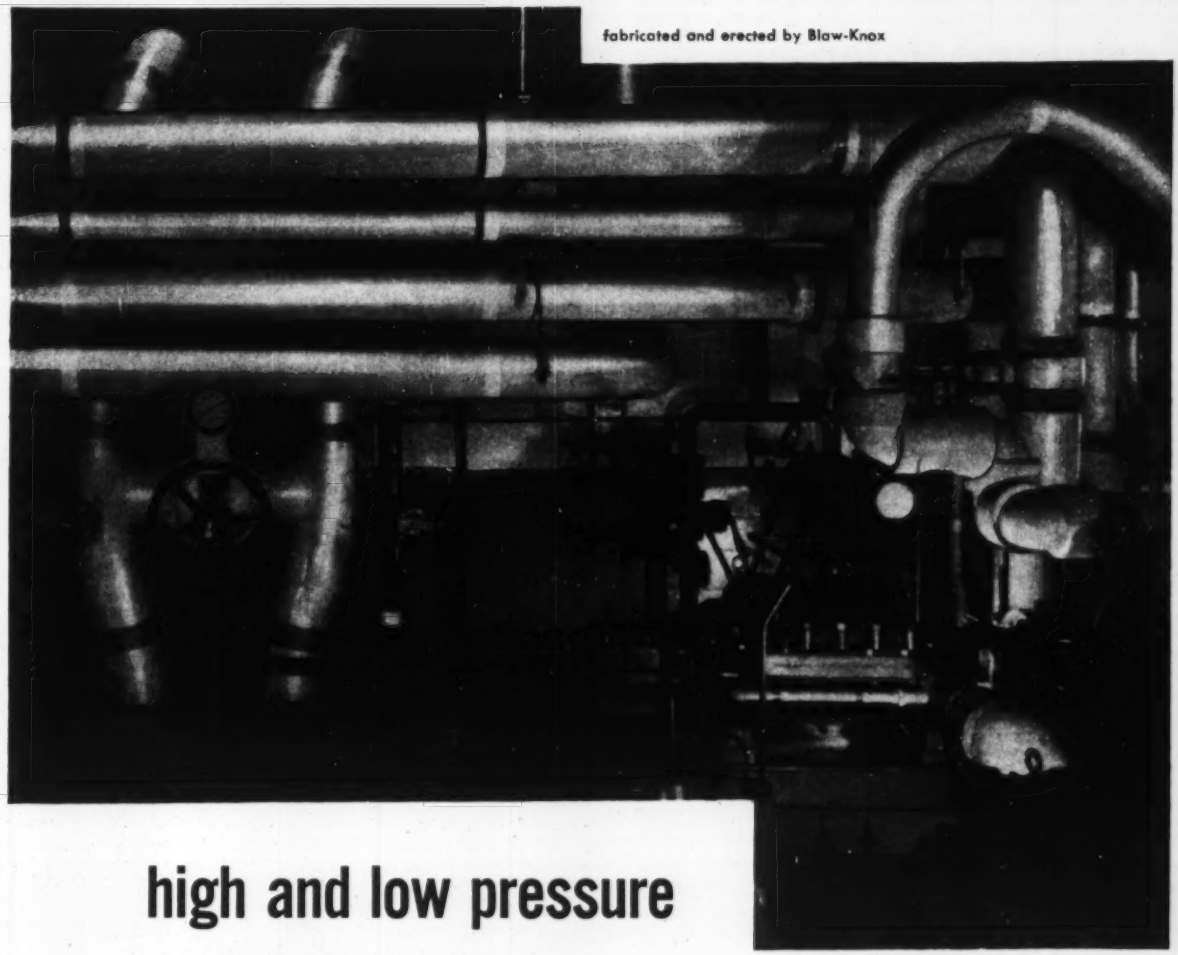

fabricated and erected by Blaw-Knox

high and low pressure boiler feed piping . . . in large steel mill

To get more information on piping for industry write for your copy of Bulletin No. 2443.

When you need a piping system similar to this one . . . or a system for any pressure and any temperature requirements . . . you can readily obtain the benefit of our long experience in this field. We'll take the job from original engineering to final erection. Always in close cooperation, of course, with your consultants or your own organization.

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And a complete service force equipped with modern machinery for field erection . . . plus the necessary manpower to handle jobs of any size.

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We can readily (1) engineer, fabricate and erect your job . . . or (2) simply fabricate and erect . . . or (3) fabricate only.

Our engineers will quote from your drawings . . . or, when desired, make a field study of your piping requirements before quoting.

Let us know your service requirements . . . and we'll provide what you need.

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Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

Engineers' Reference Books

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METALS ENGINEERING-DESIGN

Published1953. $10.00—One of the four-volume ASME Handbook, this book discusses the essential properties which need to be evaluated by the design engineer in his selection of one material over another. Comprising 48 sections and written by 43 well-known authorities, it deals with the over-all problem of selection of material and takes up such specific items as high temperature considerations, plasticity, residual stresses, vibration, fatigue, shot peening, cold working, nitriding, flame strengthening, impact, corrosion, non-destructive testing, surface finish and mass production, and design theory and practice.

METALS PROPERTIES

Published 1954. $11.00—This second of the four-volume ASME Handbook provides, in convenient charts and tables, data on a broad range of metals in common industrial use—AISI steels, ASTM steels, cast copper alloys, aluminum alloys, tin, magnesium, etc. Tabulated under each of the more than 500 metals listed is such information as the chemical composition of the metal; its brittleness, heat treatment and other characteristics; its industrial uses; treatment temperatures for forging, annealing, quenching, etc.; such technological properties as recrystallization temperature and hot working temperature, and a great deal of other pertinent information to help the designer choose the proper metal for each part or product.

MANUAL ON CUTTING OF METALS WITH SINGLE POINT TOOLS

Published 1953. $10.00—This book contains shop-tested data on the machining of high nickel alloys, stainless steels, copper and brass alloys, magnesium, cast irons and plastics. It offers valuable information on the structure of the metals to be machined, the correct tool material, size and shape of cut, and the proper cutting fluid. It shows how to predetermine the power requirements and best operating speed for all jobs. It helps time study men to set standards of practice and cost of production, and it provides 322 tables of cutting speeds and horsepower for various feeds and depths of cut when turning commonly used steels and cast iron.

GENERAL DISCUSSION ON HEAT TRANSFER

Published 1951. $10.00—This is an authoritative reference on a decade's development in heat transfer and in the design of apparatus relating thereto. The 93 contributions and discussions in its 500 pages provide first-hand information on heat transfer with change of state; heat transfer between fluids and solids; conduction in solids and fluids; radiation, instrumentation, measurement techniques, and analogies; special problems such as heat transfer in turbine blade cooling, in liquid metals, in gas turbines, in piston engines, the mercury boiler, etc.

DESIGN DATA AND METHODS

Published 1953. $4.00—This 200-page compilation includes formulas and methods of calculating stresses in beams, bars, columns, plates, shafts, and crane hooks; stress component formulas; procedures for computing stresses and deformation in pressure vessels; design data on press- and shrink-filled assemblies and also for piping; factors of working stresses; numerical values of tangential stress in thick-walled cylinders; numerical solution of problems of gas flow when properties change continously; graphical and numerical procedures for method of characteristics for two dimensional supersonic flow; chart for oblique shock waves under water; accurate bearing calculations; and methods of treating and solving problems of vibration and balancing of rotating apparatus.

DYNAMICS OF AUTOMATIC CONTROLS

Published 1948. $6.00—This complete and lucid treatment of the subject has been written for engineers who use or must eventually use automatic controllers. It examines the functional elements of a control, surveys and describes the mathematical methods of handling control problems, deals with the important components of the control loop, and specific control problems, considers the causes of nonlinearities in the control loop, and the on-off controller and its field of application. The theory of excursion-dependent periodic regulation is fully covered, formulas for the Laplace transformation are given, and the essential concepts concerning difference equations are presented.

AUTOMATIC CONTROL TERMINOLOGY

Published 1954. $1.00—This edition has been broadened to include automatic control combinations and the concepts common to the field of feedback control systems as they apply in industrial process control. Forty-six illustrative diagrams are presented to assist users to gain an understanding of the definitions. There is an index of non-standard terms listing the standard terms which supersede them, and also an alphabetical list of standard terms showing the classification under which each definition will be found.

SMALL PLANT MANAGEMENT

Published 1950. $7.00—This is a well rounded management aid which will help you in setting up an internal organization that will function smoothly, in choosing the production process, in machine and equipment planning, and creating a good distribution system. Pertinent topics discussed are financing and banking, how to organize the plant, principles of scientific management, rating products, choosing the legal form of the organization, getting the best workers and labor relations, technical research, obtaining the best facilities and materials, and about everything else that would be likely to interest an individual or a group planning to start a small manufacturing business.

TEN YEARS' PROGRESS IN MANAGEMENT, 1942–1952

Published 1953. $1.50—Prepared in collaboration with fifteen nationally recognized authorities, this Report reviews and appraises the significant achievements made in such areas as statistical quality control; production planning and control; work simplification; wage incentive; industrial plant operation; purchasing, marketing, and distribution; personnel; public and labor relations; cost accounting; federal administrative management; and international cooperation.

REHEAT TURBINES AND BOILERS

Published 1952. $2.00—Aspects of reheating treated include advantages and disadvantages of the reheat cycle; normal, start-up, quick start-up, and shutdown of modern reheat boilers; design factors relating to performance and operation of reheat boilers; performance of several new reheat boilers and special features of operation; starting schedules after shutdown of various durations; reheat economies; conversion to centralize control of auxiliaries; temperature control; turbine overspeed control as affected by reheat; and reheat development during the past twenty-five years.

VISCOSITY OF LUBRICANTS UNDER PRESSURE

Published 1954. $5.00—This publication reviews and coordinates twelve experimental investigations made in England, Germany, Japan, Russia and the United States over a period of thirty-five years. The tests were made on 148 lubricants comprising of 25 fatty oils, 94 petroleum oils, 17 compounded oils and 12 other lubricants. Data are coordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent aspects such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. The required computation of the temperature coefficients of viscosity, the method of computing pressure coefficients, a bibliography of 189 items, and symbols used are also given.

POWER BOILER CODE

(Section I) 1952 Edition. $3.00—This Code consists of the construction rules and an extensive appendix containing matter which is not mandatory unless referred to in the code. Rules apply to stationary boilers, unfired steam boilers, pipe connections up to and including the valve or valves, superheaters, economizers, and other pressure parts connected directly to the boiler without intervening valves.

BOILERS OF LOCOMOTIVES CODE

(Section III) 1952 Edition. $1.25—The rules of this Code apply to boilers which are not subject to federal control. They cover such details as materials, working pressures, thickness of plates and tubes, riveting, valves and fittings, welding, and stamping.

LOW-PRESSURE HEATING BOILER CODE

(Section IV) 1952 Edition. $1.25—This is the code to consult for rules covering the construction of steel plate and cast iron steam and hot water boilers—the former to be operated at pressures not exceeding 15 psi and the latter at pressures not exceeding 160 psi or temperatures not exceeding 250 F.

MINIATURE BOILER CODE

(Section V) 1952 Edition. $1.00—These construction and fabrication rules are for boilers that do not exceed the following limits: 16 in. inside diameter of shell, 42 in. over-all length of outside of head at center, 20 sq. ft. water heating surface, and 100 psi maximum allowable working pressure.

UNFIRED PRESSURE VESSEL CODE

(Section VIII). 1952 Edition with 1954 Addenda. $5.50—This code covers the use of all classes of materials and methods for fabricating vessels of carbon and low-alloy steels, nonferrous materials, high-alloy steel, cast iron, and clad and lined materials by riveting, welding, forging and brazing.

WELDING QUALIFICATIONS

(Section IX) 1953 Edition. $1.50—This Edition includes the requirements for ferrous as well as nonferrous materials and incorporates revisions approved after the issuance of the 1952 Code. Set forth are the tests which a manufacturer or contractor must make to qualify the welding procedures he uses in the construction of weldments built under this code, and the rules for determining the ability of the welders and welding operators to make sound welds.

ASME SCREW THREADS MANUAL FOR SHOP AND DRAFTING ROOM

Published March 1952. $2.50—The Manual gives shopmen a practical substitute for the American Unified Standards for Screw Thread and their Gages. It contains only the most used and essential standard dimensions, i.e., coarse, fine, and 8-pitch series of classes 2A and 2B from the smallest to those of 1 1/4" nominal diameter, concise descriptions of the thread features and applications, and important related information not found in the Standards.

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The new reducers can be readily motorized, if desired. A bell housing is available to accommodate standard NEMA C-type flanged motors. Expensive couplings are not required since a tang-type drive sleeve and suitably machined worm are provided with the bell housing to match the motor shaft being used.

Standard reduction ratios range from 5:1 to 60:1. When the motor is connected to the input shaft by means of vee-belts or pulleys, additional speed reduction can be easily obtained. Bore sizes are available to accommodate shafts from 1" to 2½" in steps of 1/16". All sizes are available from stock.

Complete engineering details are available in Bulletin CD-323. It's free for the asking.

CONE-DRIVE GEARS
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DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
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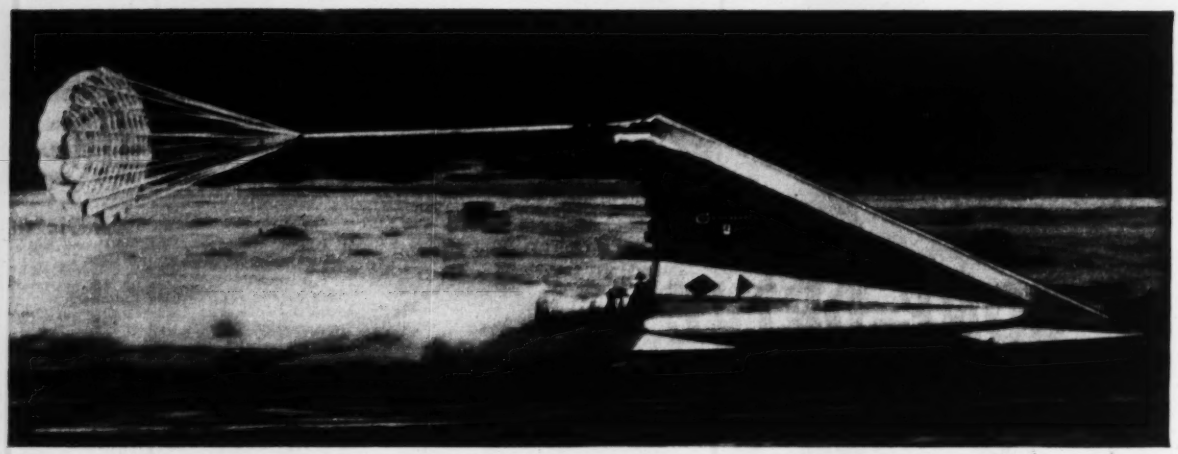
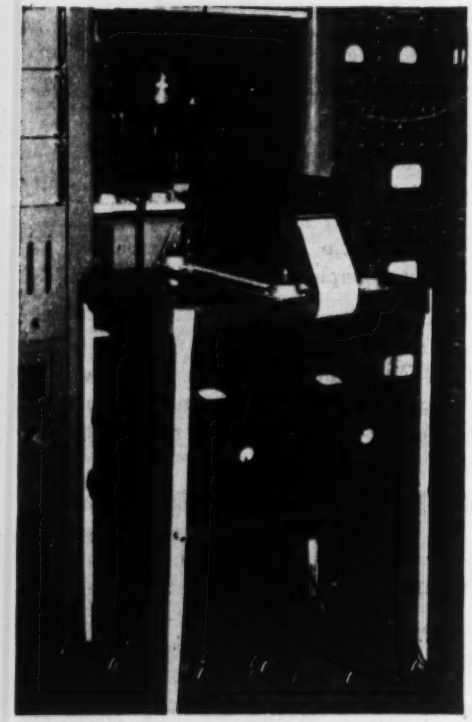


WHOOSH!

CAN THE PARACHUTE TAKE IT?



Brush Amplifiers and Oscillographs provide chart records of test data when tape recordings are "played back." Brush Instruments, which are ruggedly built and portable, provide instantaneous high-speed recording on chart paper.

Brush Instruments give the answers in writing

This rocket-propelled test sled, developed by Cook Research Laboratories, a division of Cook Electric Co., Chicago, roars down the rails at Edwards Air Force Base at speeds up to 1500 miles an hour – then the parachute is opened. The resulting drag, oscillation, strain and many other factors are recorded on magnetic tape to help engineers develop more efficient parachute designs.

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Versatile Brush Recording Instruments save testing time and simplify analysis in studies of stress, strain, force, torque, vibration and other mechanical or electrical variables. For help on *your* measurement problems call your nearby Brush representative, or write Brush Electronics Company, Dept. P-10, 3405 Perkins Avenue, Cleveland 14, Ohio. In Canada: A. C. Wickman, Ltd., Toronto.

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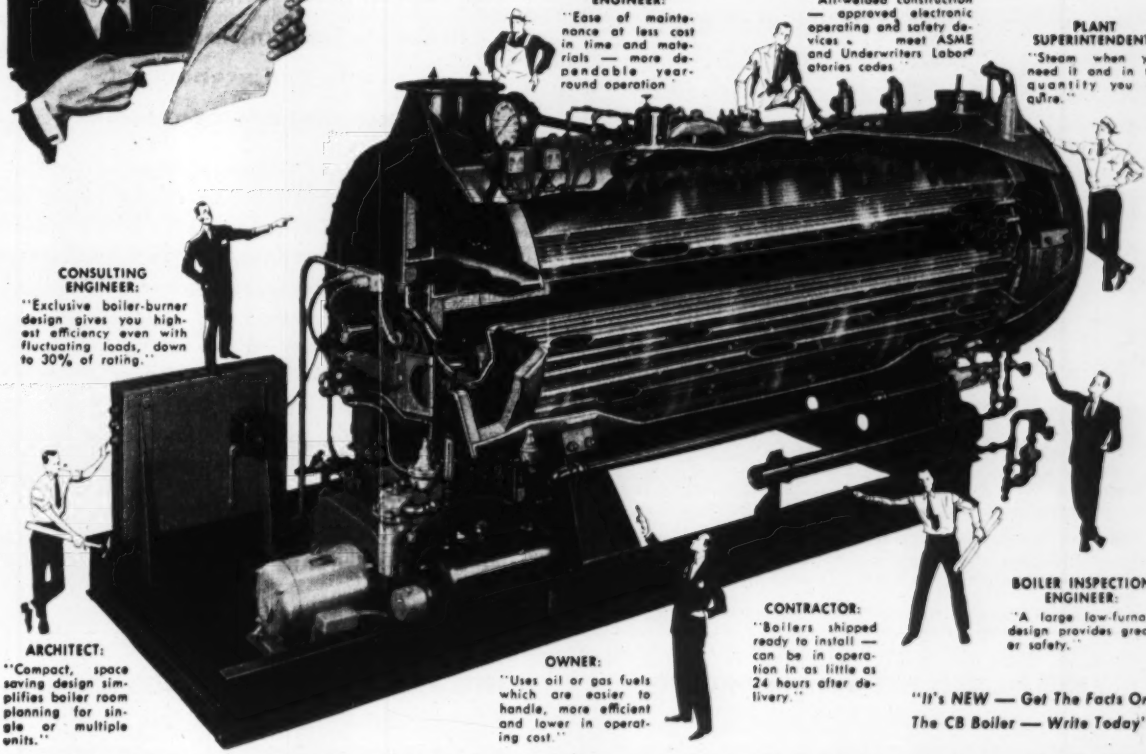
STARTS WITH FEATURES LIKE THESE



OPERATING ENGINEER: "Ease of maintenance at less cost in time and materials — more dependable year-round operation."

INSURANCE INSPECTOR: "All-welded construction — approved electronic operating and safety devices . . . meet ASME and Underwriters Laboratories codes."

PLANT SUPERINTENDENT: "Steam when you need it and in the quantity you require."

CONSULTING ENGINEER: "Exclusive boiler-burner design gives you highest efficiency even with fluctuating loads, down to 30% of rating."

ARCHITECT: "Compact, space saving design simplifies boiler room planning for single or multiple units."

OWNER: "Uses oil or gas fuels which are easier to handle, more efficient and lower in operating cost."

CONTRACTOR: "Boilers shipped ready to install — can be in operation in as little as 24 hours after delivery."

BOILER INSPECTION ENGINEER: "A large low-furnace design provides greater safety."

"It's NEW — Get The Facts On The CB Boiler — Write Today"

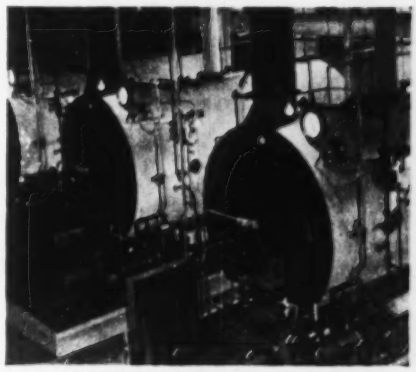
that's why you profit most from Cleaver-Brooks self-contained boilers

• Top to bottom, inside and out, you get more money-saving features when you specify or buy Cleaver-Brooks self-contained boilers. You make an *investment in quality* that pays off in lowest net cost per pound of steam for processing or heating.

YOU BENEFIT from more than 20 years of experience, working closely with men who have made it their business to be *right* about boilers. You profit from complete coordination throughout planning, installing, supervising and final operation.

YOU BENEFIT from self-contained design and original four-pass construction. These Cleaver-Brooks engineered "firsts," plus forced draft, 5 sq. ft. of heating surface per boiler hp, and exclusive burners, all contribute to highest heat transfer. Guaranteed 80% thermal efficiency when firing with oil is the direct result!

Whether you're planning a new steam plant or modernizing, make certain you get the complete Cleaver-Brooks story before you buy. See your Cleaver-Brooks representative, or write for catalog AD-100. Cleaver-Brooks Company, Dept. L-318, 326 East Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. *Cable Address CLEBRO — Milwaukee — All Codes.*



One typical owner can count on yearly savings ($15,000 fuel and $10,000 labor) from this battery of three 150 hp Cleaver-Brooks self-contained boilers.

•

NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

•

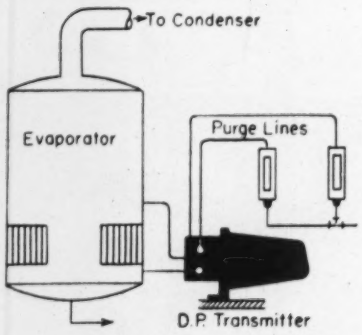
Cleaver Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

BOILERS . . . STEAM OR HOT WATER . . . FOR HEATING OR PROCESSING, IN SIZES FROM 15 TO 500 hp, 15 to 250 PSI.

GOOD FOR EVERY DAY AND SUNDAYS TOO!

AUTOMATIC PURGING OF SUSPENDED SOLIDS



Problem: To obtain uninterrupted liquid level measurement and control where solids in suspension could settle out, plugging lead lines and causing errors in measurement.

Solution: Dual taps provide for complete flushing of the 333RD body as well as the lead lines.

Result: Consistently high accuracy. Flushing of manometer and lead lines cuts maintenance to a minimum. Evaporator efficiency is kept at a uniformly high level.

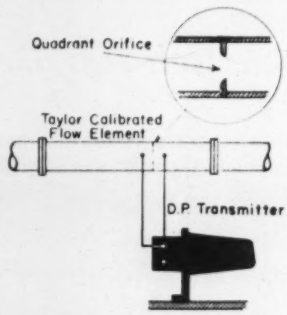
The Taylor TRANSAIRE* Differential Pressure Transmitter (333RD) is simple and economical, yet exceptionally adaptable!

IT'S inexpensive and easy to install—and to maintain. Changes in product or seasonal demand cause no problems, due to quick, simple range change feature. No seal pots—follows flows quickly because of low volumetric displacement. This pneumatic force-balance transmitter, designed to convert differential pressure into an equivalent 3 to 15 psi output, can be used to measure flow of liquid, steam or gas; liquid level or specific gravity. Pressure rating is 1500 psi, and it's available in any desired range from 20″ to 800″ of water.

Call your Taylor Field Engineer for details, or write for **Bulletin 98097.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

*Reg. U.S. Pat. Off.

HIGH ACCURACY WITH VARYING VISCOSITIES

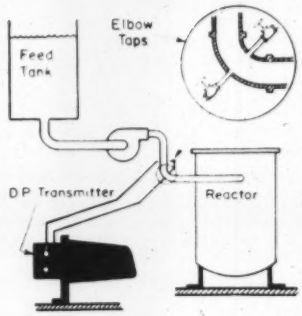


Problem: To get a high order of accuracy in measuring viscous fluids without special calibration curves and frequent changes in calibration due to troublesome variations in viscosity.

Solution: Its low volumetric displacement makes the 333RD transmitter ideally suited to capitalize on the improvements made possible by the recently developed European type quadrant orifice.

Result: Uninterrupted, accurate performance under difficult and variable viscosity conditions.

REVERSING FLOWS AND VARYING VISCOSITY



Problem: Flow control when there are changes in direction of flow and restrictions in the line are not desirable.

Solution: The use of the 333RD transmitter with Elbow Taps, as primary elements. Since there's a tendency to cavitation at the inside tap, the low volumetric displacement of the 333RD makes it particularly suitable.

Result: Accurate measurement, and consequently control, under very difficult conditions.

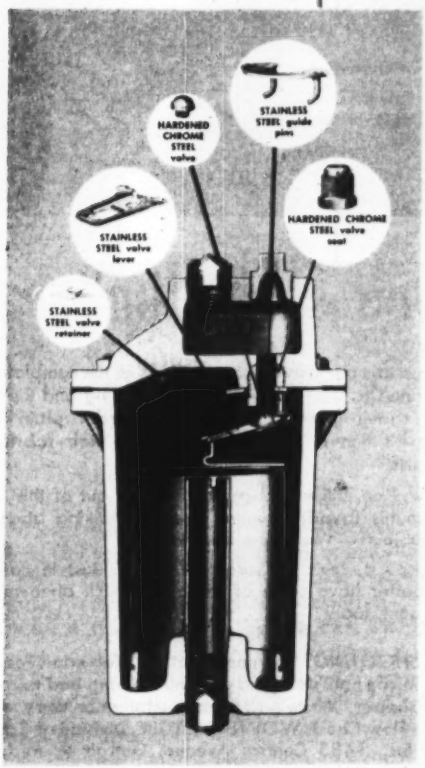
Taylor Instruments **MEAN ACCURACY FIRST**

You will always get better results by putting a Steam Trap on each Steam Coil, Chest or Unit

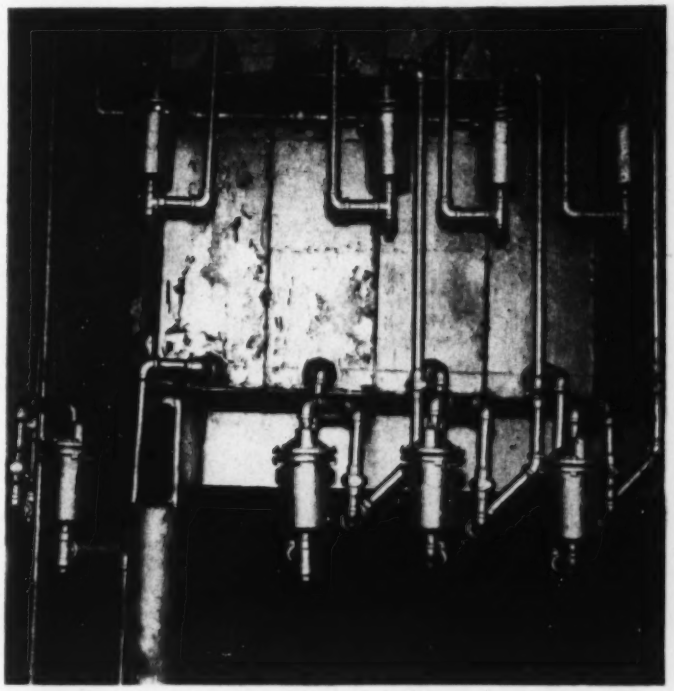
EXAMPLE

Dryer Temperatures at
Guelph Creamery, Guelph, Ontario.

WITH GROUP TRAPPING (5 steam traps for 10 coils)	**225°F**
WITH BLOW-THROUGH (no steam traps)	**250°F**
WITH ARMSTRONG UNIT TRAPPING (10 traps—one on each of 10 coils)	**309°F**


HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer

One of the big advantages of Armstrong traps is LOW MAINTENANCE. Mechanisms in low and medium pressure traps identical in design, workmanship and materials to those in 900°F, 900 psig traps.



● The example at the upper left is simply one of thousands that bear out the benefits of "Armstrong *Unit* Trapping".

When you analyze it, the reason is quite obvious. No two steam coils, chests, chambers or machines will condense steam at exactly the same rate under operating conditions. There is a greater pressure drop in the units that condense the fastest. Steam will backflow through a common drain line from a higher pressure unit to a lower pressure unit. This blocks off flow of air and retards condensate flow from the lower pressure unit. On the other hand, if you separate each unit with its own trap, that can't happen.

You will *always* get higher temperatures and lower production costs with unit trapping. Ask your Armstrong Representative about it, or write:

ARMSTRONG MACHINE WORKS
894 Maple Street, Three Rivers, Michigan

FREE—STEAM TRAP BOOK

If you don't have a copy of the 44-page Armstrong Steam Trap Book, we'll be glad to send you one. No obligation.

ARMSTRONG STEAM TRAPS

"Looks like everything you said, Jim"

"This is the spot I was telling you about, Ken. Good cover, good feed, lots of birds, not many hunters. Bill Brown and I got our limits here the other day. Boy, is he a terrific shot!"

"He was telling me about it too, Jim, and it sure looks like everything you said. Bill stopped in yesterday with prints on those aluminum extrusions Wolverine is making for us. Their Tubemanship is even better than Bill's marksmanship. I was certainly impressed with those prints. Did you ever see that Alabama plant of theirs—in Decatur?"

"No, but I've seen the pictures Bill has."

"They don't do it justice. When you see it for yourself you realize why it's called 'the world's most modern tube mill'."

"It's close to your southern branch, isn't it?"

"Less than 200 miles away. We do a lot of business with Bill. Not only in aluminum tube and shapes but in copper and copper-base alloy as well. For us dealing with Wolverine is like having two sources."

"Two sources. How do you mean?"

"Well, their Detroit plant is also one of the finest and we often order our welded steel tube there for our eastern plant."

"Say, that must save a lot of 'shopping around'."

"It does and in more ways than one. We like the completeness of Wolverine's facilities. We use a lot of tubing and they can meet our requirements. Sometimes we order plain tube; sometimes it's finned. Quite often we use their fabricated tubular parts."

"You know, Ken, Bill would get a real kick out of this. Here we are on his favorite hunting grounds talking about his favorite subjects—Wolverine and hunting."

"Terrific, isn't it. Let's be sure to tell him. Just in case he asks we better have some of those ring-neck pheasants to tell him about, too."

• • •

SURE AS SHOOTING: You can count on Wolverine Tube for the finest in copper, steel and aluminum tubing and extruded aluminum shapes. Write—right now—for your copy of the Wolverine Flow Chart. WOLVERINE TUBE, Division of Calumet & Hecla, Inc., 1483 Central Avenue, Detroit 9, Michigan.

WOLVERINE TUBE

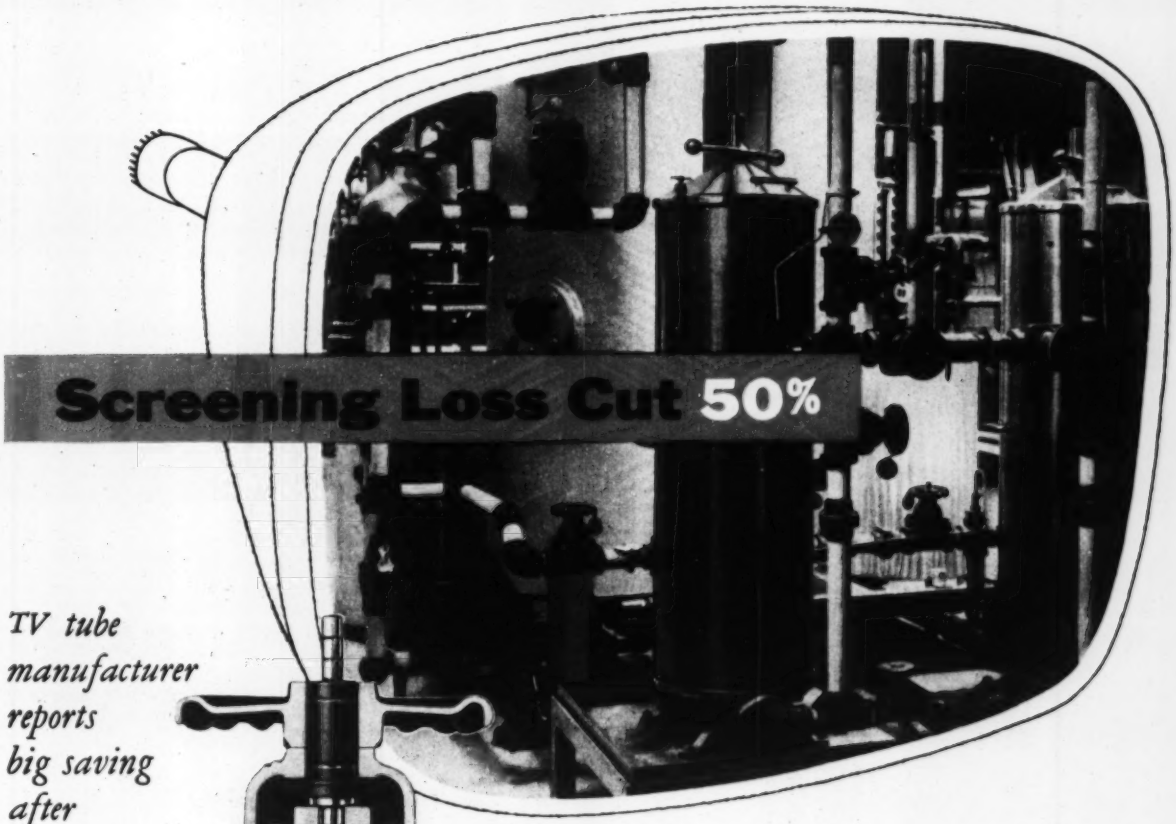
DIVISION OF CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

Wolverine Trufin available in Canada through the Unifin Tube Co., London, Ontario

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, N. Y.



Screening Loss Cut 50%

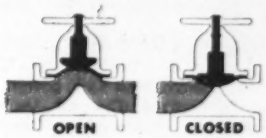
TV tube manufacturer reports big saving after installing...

Grinnell-Saunders Diaphragm Valves

Radio Valve of Toronto faces this problem. In making its TV tubes, large quantities of the purest water possible are needed. Obliged to use regular city water, Radio Valve's first job is to filter this water to make it sterile and free of minerals. Next, 2 or 3 gallons are introduced into each TV tube. A fluorescent powder is added, which is allowed to settle on the screen. After decanting the water, screens are checked for flaws. Obviously, impurities in the water mean flaws in the screen, and a loss of time and money.

Since the installation of Grinnell-Saunders Diaphragm Valves, this user reports screening losses cut in half! Contamination of the purified water is eliminated, because the water passing through the valve is completely isolated from the valve mechanism. Of the Grinnell valves in this service, approximately 90% are stainless steel.

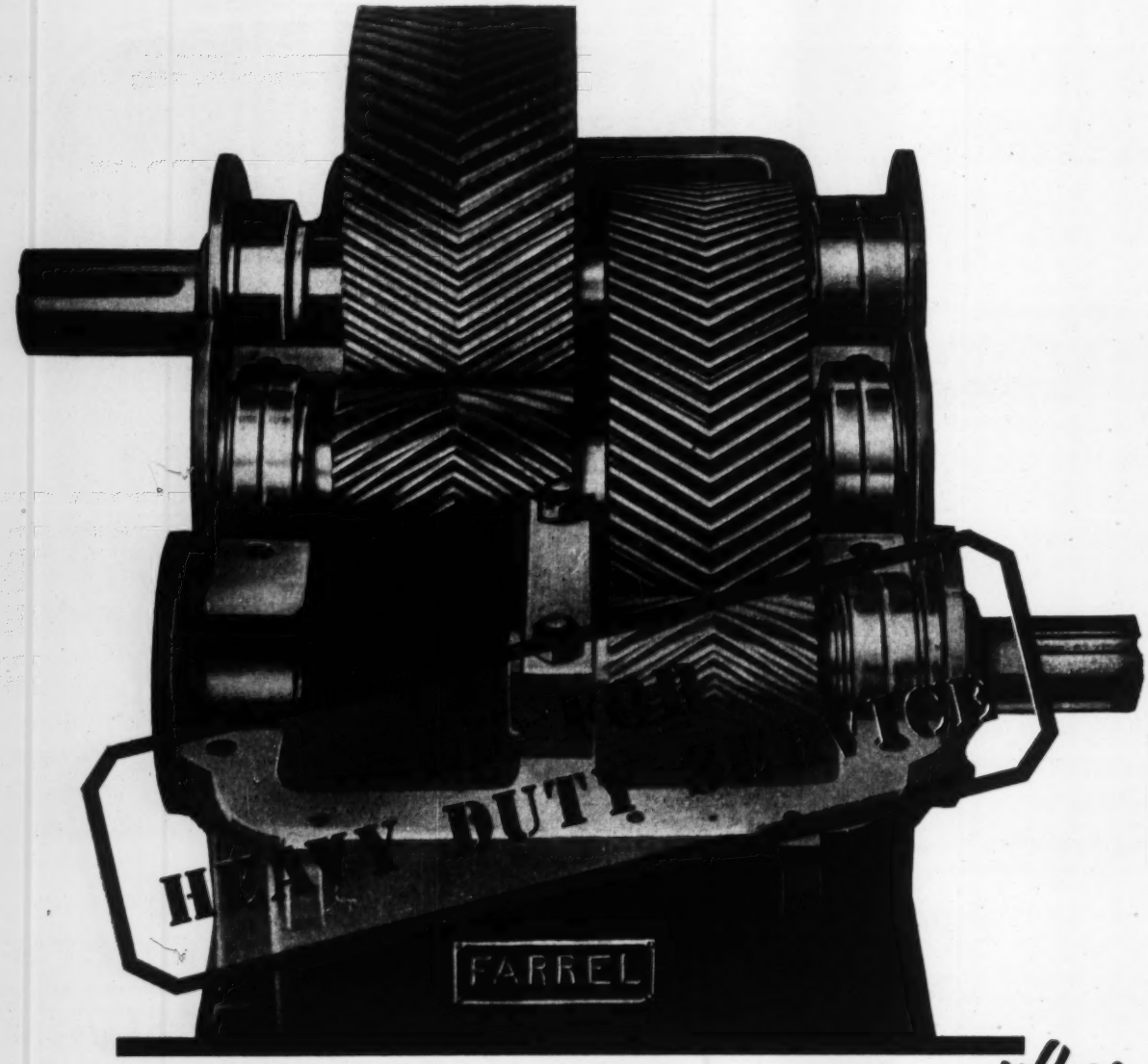
With the Grinnell-Saunders valve, the flexible diaphragm lifts high for streamline flow, in either direction; closure is positive against pressure or vacuum. There are no packing glands to demand attention; no metal-to-metal seats to become damaged or wire-drawn; no refacing or reseating. Body, lining and diaphragm materials are available to meet different service conditions. Write for full details.



GRINNELL
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



Farrel speed reducers can be relied on for dependable operation where conditions of service are unusual and exacting. The ability to adapt these units to specific requirements results from design experience gained by successfully solving innumerable problems requiring freedom in gear judgment.

To suit the application, the gears and pinions of Farrel speed reducers can be proportioned to meet specific load, speed and service conditions . . . input and output shafts can be varied in size, in material and in extension . . . housing dimensions can even be changed to meet problems in mounting.

Farrel supplies these units in a wide range of ratios and capacities. Designs include single, double, and multiple reduction units, speed-change units having two or more selective speeds, right angle drives, and drives to meet special requirements. Ask for Bulletin 449.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Akron, Detroit, Chicago, Memphis, Minneapolis, Portland (Oregon), Los Angeles, Salt Lake City, Tulsa, Houston, New Orleans FB-930

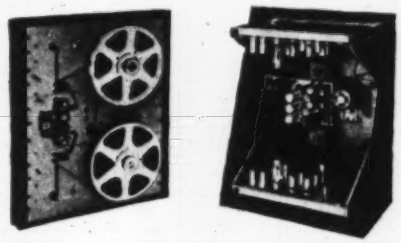
Farrel-Birmingham ®

Here's Why

1. **PRECISION GEARS** have teeth generated by the famous Farrel-Sykes method—a process that assures accuracy of tooth spacing, profile and helix angle.
2. **OVERSIZE SHAFTS** are large for the power to be transmitted, giving added stiffness against bending and torsional deflection under peak loading variations.
3. **HIGH CAPACITY ROLLER BEARINGS** take radial and normal thrust loads, hold the shafts in precise alignment.
4. **CONTINUOUS SPLASH LUBRICATION** reliably supplies oil to all bearings and gear teeth.
5. **STURDY HOUSING** holds rotating elements in original alignment, preserves operating smoothness of the gearing.

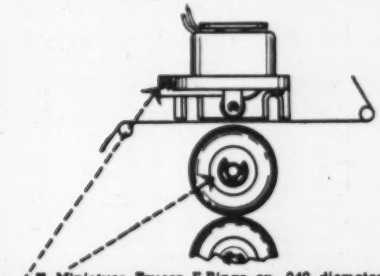
30 Waldes Truarc Rings Save Space and Time... Simplify Assembly and Disassembly

Potter's New Digital Magnetic Tape Handler



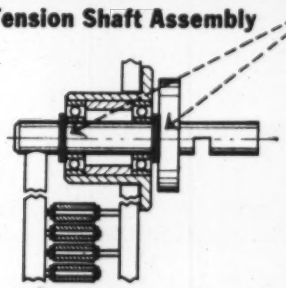
■ Prime requirements: fast starts, fast stops, fast tape speeds, great accuracy. Using Truarc rings, this new model starts and stops the tape within 5 milliseconds, has tape speeds up to 60 inches per second.

Solenoid Mount and Capstan Assembly



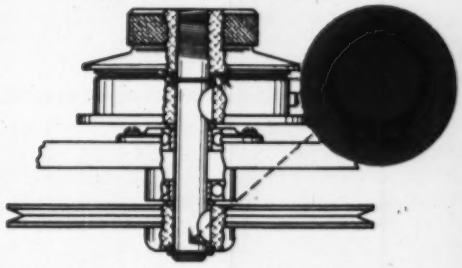
■ Miniature Truarc E-Rings on .040 diameter shaft and on continuously running capstans eliminate projecting bolts and screws. Rings permit rapid assembly and disassembly, fast replacement of worn rubber capstans.

Tension Shaft Assembly



■ Truarc E-Rings snap quickly into place, act as shoulders for the ball bearings with a minimum of friction. Additional Truarc Rings are used as spacers on shafts, can be located accurately to extremely close tolerances.

Reel Shaft Assembly



■ Truarc Standard Rings (Series 5100) hold the reel shaft assembly firmly in place and permit the use of quick-lock hubs so that the reel tapes can be changed in seconds as they are finished.

Potter Instrument Company, Inc., of Great Neck, L. I., uses 30 Waldes Truarc Retaining Rings in their new Model 902 High Speed Digital Magnetic Tape Handler. In addition to solving a variety of fastening problems, Truarc Rings facilitate the rapid acceleration and fast stopping needed in these machines.

Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better, more economical job. Truarc Rings are precision engineered, quick and easy to assemble and disassemble. They save time and increase operating efficiency.

Find out what Waldes Truarc Retaining Rings can do for you, toward saving costs and improving your product. Send your blueprints to Waldes Truarc Engineers for individual attention without obligation.

SEND FOR NEW CATALOG ➧

WALDES

TRUARC

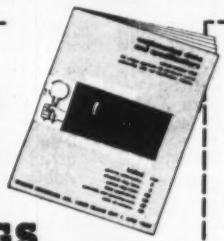
REG U S PAT OFF

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,392,940; 2,418,892; 2,430,921; 2,439,241; 2,439,709; 2,441,840; 2,455,165; 2,483,390; 2,483,393; 2,487,903; 2,487,903; 2,491,306; 2,509,091 AND OTHER PATENTS PENDING

For precision internal grooving and undercutting... Waldes Truarc Grooving Tool!



ME 106

Waldes Kohinoor, Inc., 47-16 Austel Pl., L. I. C. 1, N.Y.

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print)

Name .....

Title .....

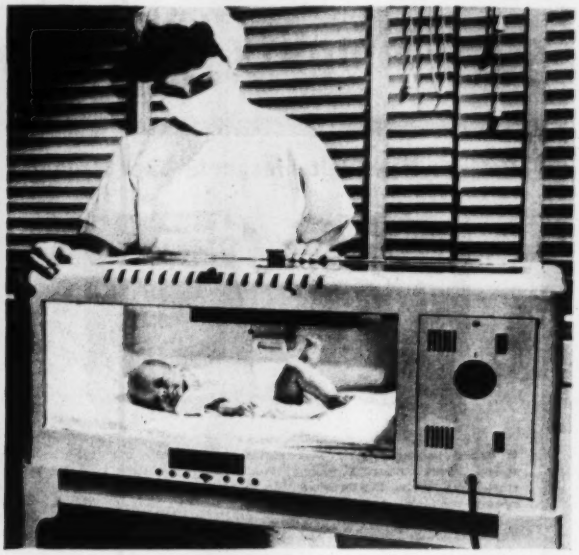
Company .....

Business Address .....

City ..... *Zone* ..... *State* .....

How would YOU solve these two problems?

1. MEN AND WOMEN BOTH like nylon fabrics. Important key to producing successful nylon fabrics is the heat-setting process. Temperature-control must be accurate, and reliable yet readily adjustable. "National" Nylon Heat Setting Machines used by the leading textile mills employ THERMOSWITCH® units in the heated rollers . . . get highest efficiency . . . greatest safety . . . most economical fuel consumption.



2. BABY INCUBATOR MUST BE SAFE. Engineers who design Armstrong Baby Incubators say "Safety is a *must* where babies are concerned. That is why all our baby incubators are tested and approved by Underwriters Laboratories. That is why we use only Fenwal THERMOSWITCH units to control all-important temperature and humidity. Inspection reports on more than 22,000 THERMOSWITCH units show a remarkable picture of consistent reliability."

3. THIS IS IT — the Fenwal THERMOSWITCH control is simple — compact shell contracts or expands *instantly* with temperature changes, opening or closing electrical contacts. Adjustable and highly resistant to shock and vibration. Fenwal THERMOSWITCH units are solving temperature problems and helping to improve the final product throughout all industry.

4. SEND FOR THIS BROCHURE for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 510 Pleasant St., Ashland, Massachusetts.

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . but only to heat

when critical piping is the order!

View of inside of pipe, showing root bead. Note the highly uniform, crack-free surface obtained through use of K-Weld method.

With today's operating conditions already approaching the limits of available power piping materials, the necessity for expert fabricating techniques cannot be overstressed. And it is here that the K-Weld* process, Kellogg's unique welding method, has already played an important part.

For example, K-Weld was used throughout—both in the shop and in the field—for the welding of austenitic stainless steam piping for service at 1100°F and 2350 psig on two 145,000 Kw units in Kearny Station of Public Service Electric and Gas Co. of New Jersey. It is also being employed in the critical piping for a similar unit at the Company's Burlington Station.

Main advantage of this new welding process lies in the fact that it assures *complete penetration without backing rings*. Their elimination precludes the possibility of crack propagation at the weld root which would produce ultimate failure as a result of severe operating conditions.

An additional advantage is the elimination of the possibility of the backing ring breaking off and damaging equipment. Furthermore the lack of a ring materially reduces turbulence in pipes.

The K-Weld process—developed in Kellogg's Welding and Welding Practices Group—entails the use of inert-gas arc welding of the first pass with inert-gas under *controlled pressure* on the inside of the piping. It permits an average welder qualified for inert-gas arc welding to obtain excellent results either in the field or in the shop. The K-Weld technique may be used on all power piping materials.

Fundamental development work leading to advances in the art of fabrication is an important part of Kellogg's basic stock in trade. Many power station designers and utility companies also say it's one basic reason why they time and again specify Kellogg when critical power piping is the order.

New Power Piping Booklet Published . . . Send for descriptive literature about Kellogg's extensive facilities for assuring the highest quality workmanship. A section of the booklet is devoted to detailed coverage of the K-Weld process.

These leading companies are among the many major producers of power who use M. W. KELLOGG POWER PIPING . . .

- Public Service Electric & Gas Co. of N.J.
- Societa Edison (Italy)
- Societe Financiere De Transports Et D'Entreprises Industrielles (Soñna) (Belgium)
- Societa Meridionale Di Elettricita (Italy)
- Sociedad De Electricidad De Rosario (Argentina)
- Union D'Electricite (France)

OTHER FABRICATED PRODUCTS include: Pressure Vessels . . . Vacuum Vessels . . . Fractionating Columns . . . Drums and Shells . . . Heat Exchangers . . . Process Piping . . . Bends and Headers . . . Forged and Welded Fittings

FABRICATED PRODUCTS DIVISION
M. W. KELLOGG

*Trade-mark of the M. W. Kellogg Company.

KELLOGG — A SUBSIDIARY OF PULLMAN INCORPORATED

KELLOGG
HIGH TEMPERATURE
HIGH PRESSURE
POWER PIPING
KELLOGG
HIGH TEMPERATURE
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HIGH TEMPERATURE
HIGH PRESSURE
POWER PIPING

One of a Series

Reasons Why DIAMOND BLOWERS Assure CLEANER BOILERS *at* LOWER COST

POSITIVE GEAR DRIVE

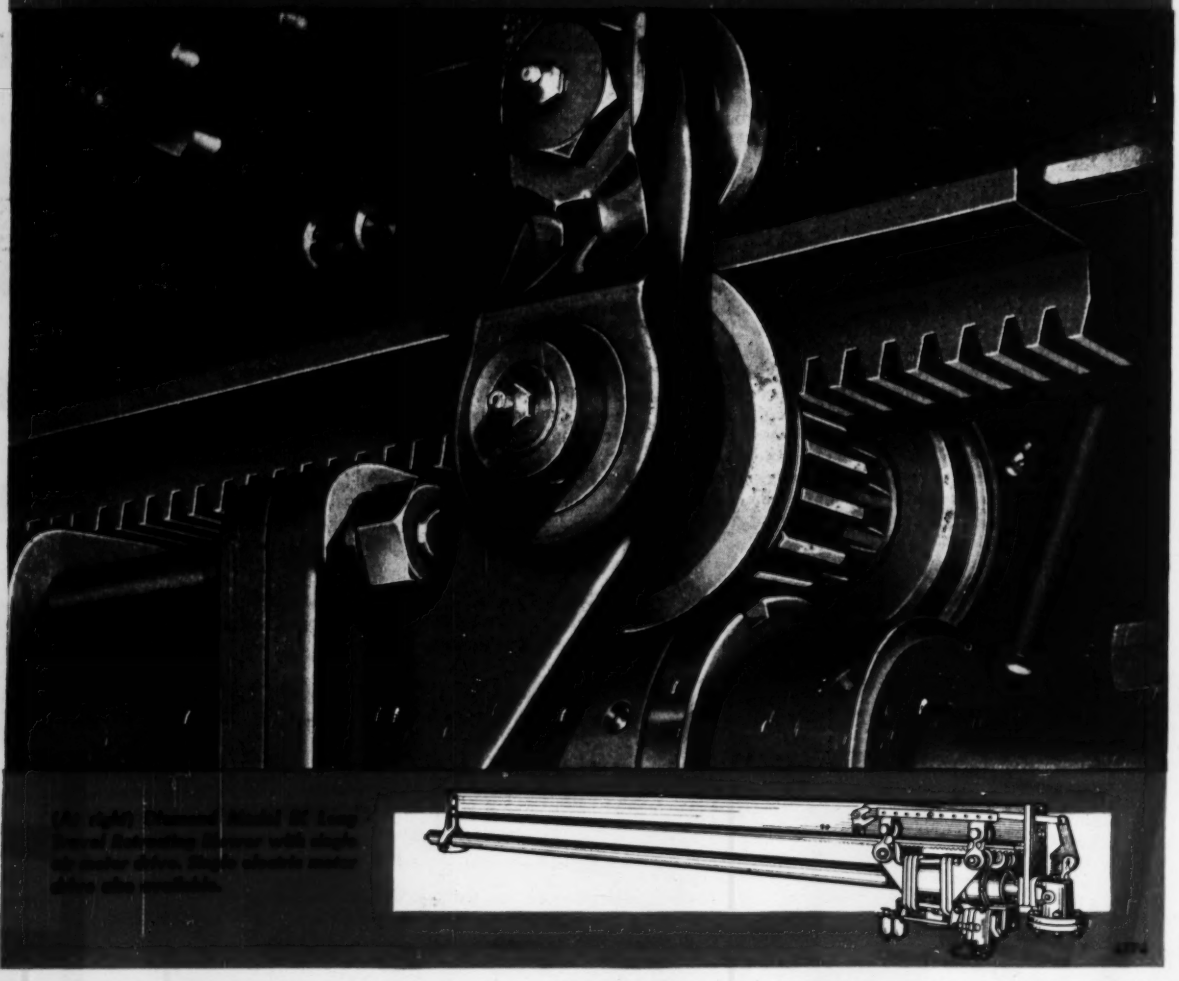
The heavy tube of the Diamond Model IK Long Retracting Blower is propelled into the furnace by the carriage which is driven by a rugged pinion gear that engages a heavy rack. Gearing will stall loose in event of motor failure during blowing. This is the ultimate in safety and reliability.

Other reasons for the superior performance of the Model IK are: (1) single motor drive (one motor simultaneously propels the carriage and rotates the lance); (2) mechanically operated poppet valve provides simple, positive and accurate control of blowing medium (air or steam); (3) integral adjustable pressure control for maximum blowing economy. Write for Bulletin [illegible] for additional information.

Diamond Blowers provide better boiler cleaning at lower cost . . . that is why they are used and preferred by the great majority of steam power plants, both large and small.

DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO

DIAMOND SPECIALTY LIMITED
WINDSOR, ONTARIO



(At right) Diamond Model IK Long Travel Retracting Blower with electric motor drive. Steam electric motor drive also available.

FOR Quality Performance from
WIRE FORMS
SPRINGS
METAL STAMPINGS
Rely on
DUDEK & BOCK
You get precision WIRE FORMS, Springs and Stampings that are easily assembled . . . that withstand stresses . . . perform under the most *trying* conditions. Rely on our free designing service. Our EXPERT ENGINEERS will produce designs that meet your *exact* needs—and save you MONEY!
Valuable FREE Brochure
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WRITE—WIRE or PHONE
for Estimates and Delivery Dates
Phone:
HAymarket 1-1880
DUDEK & BOCK
SPRING MFG. CO.
2100 W. Fulton, Chicago 12, Illinois

What's YOUR Heating or Air Conditioning Control Problem?

. . . with their 60 years of experience installing pneumatic systems of temperature and humidity control in all types of important buildings are well qualified to help you obtain the greatest return from an investment in—

ACCURATE UNIFORM CONTROL

in all types of heated or air conditioned spaces—offices, factories, process rooms, processes, research and test laboratories, packaging or storage rooms. You can gain . . .

Some Prominent Users of Powers Control:

Ford Motor Co.
Chrysler Corp.
Esso Research Center
Sears Roebuck & Co.
Bendix Aviation Corp.
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Precision Control for Processes—Wherever product uniformity and quality are dependent upon precise temperature and humidity regulation use Powers controlling, indicating or recording instruments.

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If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact anything to be offered that somebody else may want, or anything wanted that somebody else may have—*use a classified advertisement in the Opportunities Section.*

RATES

Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line, $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display matter carried in single column units of multiples of one inch at the flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

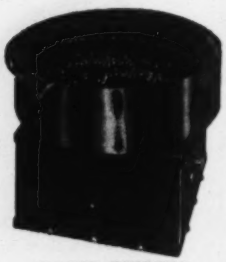
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 West 39th Street, New York 18, N. Y.

VIBRATORY EQUIPMENT by *SYNTRON*

Syntron Parts Feeders feed ceramic wafers to circuit printer in automatic assembly of electronic equipment.

A Fundamental Part Of Automatic Production

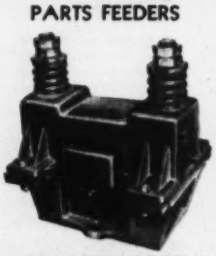
Electromagnetic drive—positive finger-tip control of operating speeds and complete absence of mechanical wearing parts, such as belts, cams, pulleys, etc., make Syntron Vibratory Equipment exceptionally well suited for incorporation into automatic or semi-automatic production systems.



PARTS FEEDERS

Parts Feeders that feed small parts of nearly any shape or material—single file—in oriented position—at controllable speeds.

Bin Vibrators that assure a positive free-flow of even the most stubborn bulk materials through bins, hoppers and chutes. Eliminate arching and plugging.



BIN VIBRATORS

Vibratory Feeders that handle most bulk materials from fine powders to coarse heavy lumps—at controllable rates—to conveyor belts, ball mills, mixers, etc.

VIBRATORY FEEDERS

Write for free catalog data — or inquire about your own handling problem.

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—*maintenance-free* LOVEJOY FLEXIBLE COUPLINGS

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TYPES AND SIZES FOR ALL APPLICATIONS

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Also Mfrs. of Universal Joints, Variable Speed Pulleys and Transmissions

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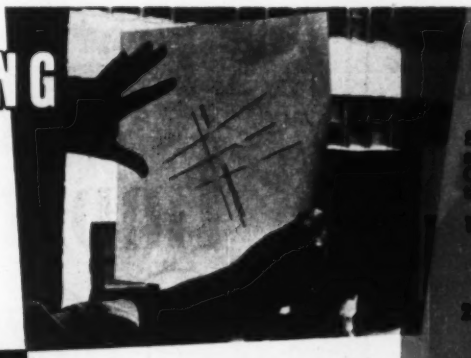

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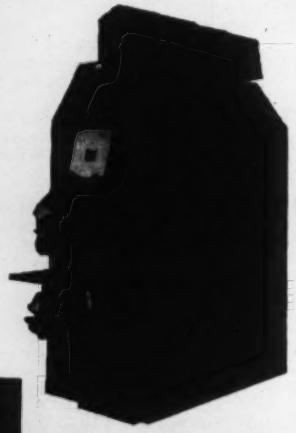

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ROCKFORD CLUTCH DIVISION

BORG-WARNER

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ROCKFORD CLUTCHES

MECHANICAL ENGINEERING

September, 1954 CARD INDEX Vol. 76, No. 9

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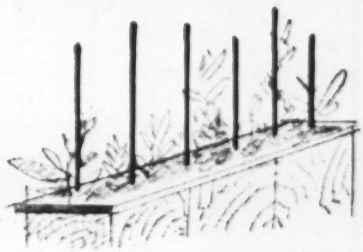
TO *jog a designer's imagination*



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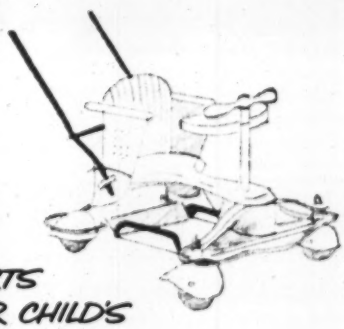
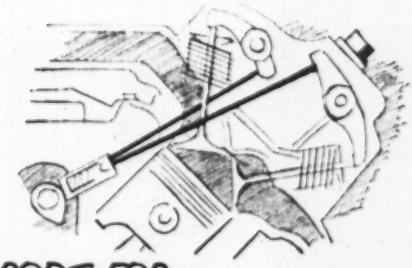


PARTS FOR CHILD'S STROLLER



PUSH RODS FOR CAR-TRUCK ENGINES

REMARKS The success (or failure) of that new tubing application hinges largely on the tubing you specify. Why not tip the scales in your favor by using strong, lightweight Bundyweld, the only tubing double-walled from a single metal strip. Added bonuses: Bundy's expert engineering assistance, unexcelled fabrication facilities.

WRITE today for catalog or for help in developing your tubing idea.

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FRAME FOR IRONING BOARD

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness,

and passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

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DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
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Shock-resistant
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Lightweight
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Bright and clean
No inside bead
Uniform I.D., O.D.

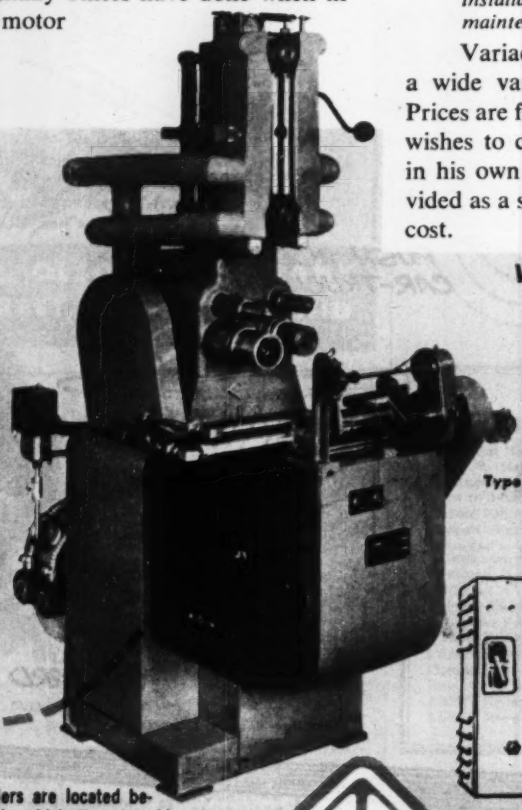
Bundy Tubing Distributors and Representatives: *Bridgeport, Conn.:* Korhumel Steel & Aluminum Co., 117 E. Washington St. • *Cambridge 42, Mass.:* Austin-Hastings Co., Inc., 226 Binney St. *Chattanooga 2, Tenn.:* Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • *Chicago 32, Ill.:* Lapham-Hickey Co., 3333 W. 47th Place • *Elizabeth, New Jersey:* A. B. Murray Co., Inc., Post Office Box 476 • *Los Angeles 58, Calif.:* Tubesales, 5400 Alcoa Ave. • *Philadelphia 3, Penn.:* Ruan & Co., 1717 Sansom St. • *San Francisco 10, Calif.:* Pacific Metals Co., Ltd., 3100 19th St. • *Seattle 4, Wash.:* Eagle Metals Co., 4755 First Ave., South • *Toronto 5, Ontario, Canada:* Alloy Metal Sales, Ltd., 181 Fleet St., E.

Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.

Another Application for VARIAC® MOTOR SPEED CONTROLS

The Hot Stretching Machine manufactured by the W. M. Steele Co. of Worcester, Massachusetts, must be started *slowly* and *evenly*. This is essential to the proper stretching and smoothing of nylon thread. There can be no sudden variation in speed which would break or weaken the yarn.

These stringent requirements led this concern to specify the Variac Motor Speed Control for this job . . . just as so many others have done when in need of a superior motor speed control.



Right-hand feed-in rollers are located before the heating element in which the stretching is accomplished, and are of smaller diameter than the left-hand take-up pair. By accurately controlling the ratio of the two roller diameters, the exact amount of nylon stretching is predetermined. For smooth control of these roller speeds, the W. M. Steele Company found the Variac Motor Speed Control the best for their purposes.

Consider some of the advantages and conveniences only this Variac Motor Control can give you.

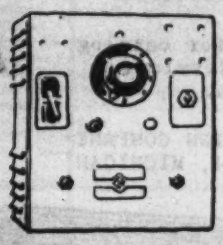
It permits operation at an infinite selection of speeds from zero to rated — instant starting, stopping or reversing — no creep when set to zero — non-pulsating torque makes for smooth control, eliminates excessive motor heating — has no electron tubes — is extremely rugged — the Variac Motor Speed Control plugs into ordinary a-c lines yet provides all the advantages accruing from operation of d-c motors — installation is simple — long life with greatly reduced maintenance — low cost.

Variac Motor Speed Controls are available in a wide variety of sizes from $\frac{1}{15}$ hp to $1\frac{1}{2}$ hp. Prices are from $75 to $495. Where a manufacturer wishes to combine this control with his equipment in his own cabinet, the basic elements can be provided as a sub-assembly at considerable reduction in cost.

Write for More Information

Type 1701-AK . . $75
1/15 hp and less

Type 1703-A . . $97.50
1/12—1/6 hp



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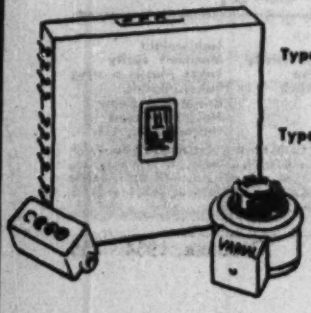
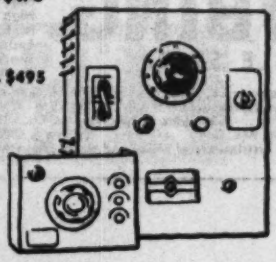


Type 1704-A . . $470
1 hp

Type 1705-A . . $495
1½ hp



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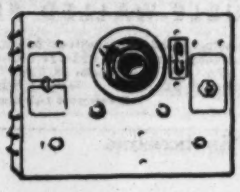
1/2—3/4 hp



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A mature engineer with administrative ability and a broad practical background of experience in construction, plant design, mechanics and cost estimation, to assume change of Engineering Department. Experience in flotation and non-metallic minerals beneficiation is desirable. The scope of the work covers producing mines and plants in the western and southern states.

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To work closely with Manager of Engineering on design of dies, patterns, jigs and fixtures and development of outside sources.

Must have at least 5 years' aerodynamic experience with turbine blades and vanes.

Permanent position with progressive, expanding firm.

Include in your resumé full details, experience, education and personal history. Reply will be treated in strict confidence.

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A unique career opportunity is now available to a graduate mechanical engineer (BS or MS) in our Engineering Department. The applicant must have 8 to 10 years of practical power experience, including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction is desirable.

The successful applicant will assist in specification of power equipment and in selection of new facilities, and will make economic evaluations and involved heat balances for complicated power systems.

Duties will include determination of causes of equipment malfunctioning and development of recommendations for corrections.

Please send complete resume including details of education and experience to:

Mr. J. C. Costello, Jr.
Personnel Section
Engineering Department

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Applicants must have Bachelor, Masters or Ph.D. degrees and a minimum of two years' experience in experimental research, design and development of control equipment and instruments.

Positions are of immediate and permanent importance to our operations. Southwestern location in medium sized community. Excellent employee benefits. Reply by letter giving age, experience and other qualifications.

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Field service representatives and engineers in design and development with experience on ordnance products.

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P. O. Box 1118
Detroit 31, Michigan

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Man with EE, ME or ChE degree. Minimum four years' technical editing and supervision of national technical trade or association publication. Qualified for top-flight interviews with engineering executives. No age limit. Permanent. Western Penna. Good salary. Confidential complete resume to

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Graduate Mechanical or Chemical Engineer with at least ten years' experience in heavy chemical industry. Large chemical metallurgical operation, foreign location. To direct all engineering and maintenance functions. Will report directly to plant manager.

In applying give details of education and experience, as well as salary expected.

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Use a CLASSIFIED ADVERTISEMENT
For QUICK RESULTS

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Address CA-4804, % "Mechanical Engineering"

control engineers

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If you are interested in any of these well paid positions located in Honeywell's new Aeronautical Plant in Minneapolis, send your resumes to:

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Director of Engineering Placement
Dept. ME-10
Minneapolis-Honeywell Regulator Co.
Minneapolis 8, Minnesota

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First in Controls

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This will be long term research, divorced from immediate development problems, with excellent opportunites for advancement. Employees are covered by group life and health insurance, contributory pension plan.

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Five Pages of "OPPORTUNITIES"

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"OPPORTUNITIES" Section This Month 137-141

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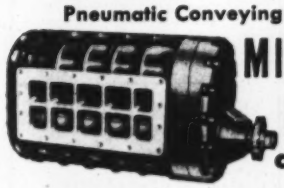

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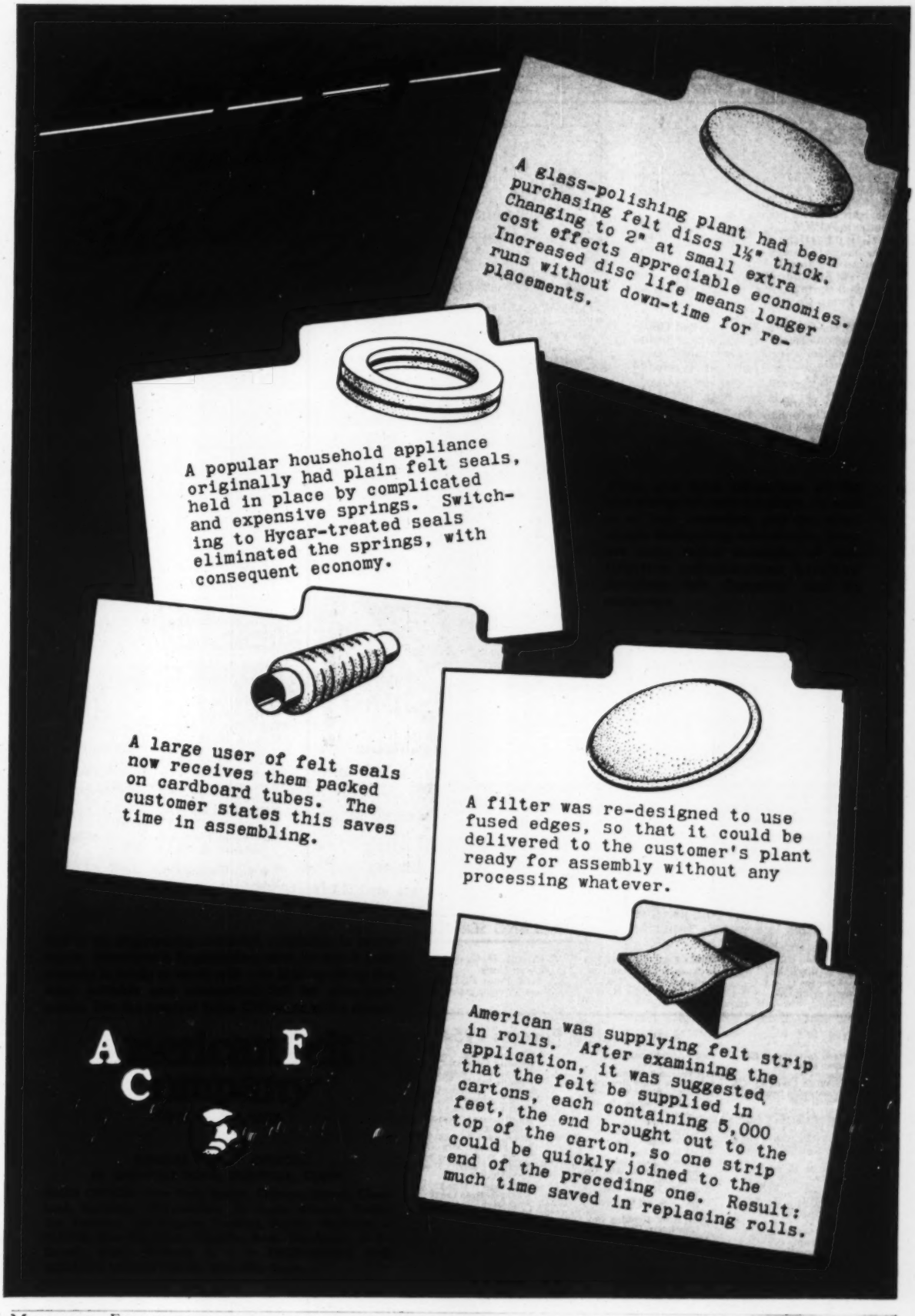
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*Posey Iron Works (Inc.)
Read Standard Corp.
Reliance Gauge Column Co.
Resolite Corp.
Ric-Wil Co.
Ronald Press Co.
Roth Rubber Co.
Sanborn Co.
*Schutte & Koerting Co.
*Seamless Co.
Servel (Inc.)
Sheffield Corp.
Sparta Mfg. Co.
*Spence Engineering Co.
Streeter-Amet Co.
*Struthers Wells Corp.
Sturtevant, P. A., Co.
Synchro-Start Products (Inc.)
Thompson-Leonard, John, Ltd.
Trabon Engineering Corp.
Trimount Instrument Co.
Waterman Engineering Co.
*Western Gear Works
*Westinghouse Air Brake Co.
*Wickes Boiler Co.
Div. of Wickes Corp.
Wiegand, Edwin L., Co.
Wiley, John & Sons
*Wing, L. J., Mfg. Co.
Winsmith (Inc.)
Winsteer Mfg. & Tool Corp.
*Zallea Brothers
Zurn, J. A., Mfg. Co.

T F

They don't come too big for TAYLOR FORGE

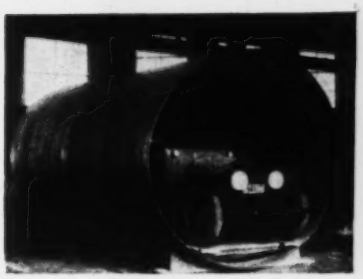
As pioneers in the making of heavy-walled large-diameter pipe, it is not surprising that Taylor Forge has developed the widest range of large welding fittings and flanges like those illustrated here.

In fact, those who know the background of Taylor Forge insist on the WeldELL® line for all requirements from smallest to largest. They have found that WeldELLS have features which are combined in no other fittings for pipe welding.

See your Taylor Forge Distributor for up-to-the-minute facts.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS • General Offices and Works: P.O. Box 485, Chicago 90, Illinois • *Offices in all principal cities*
Plants at: Carnegie, Pa.; Fontana, Calif.; Gary, Ind.; Hamilton, Ontario, Canada



The pipe was farther along than the auto!

They made their automobiles high in the days when this photo was taken at the old Taylor Forge Works, and that's why Taylor Forge chose this way of demonstrating the largest heavy-walled pipe the world of 1916 had ever known.

As a matter of fact, the pipe was farther along than the automobile; for Taylor Forge had started the manufacture of this large pipe as early as 1907. Before then, pipe had been just a tube for conveying fluids, but by 1907 there was a widespread call for large, rated pipe to withstand widely varied and exacting services.

Taylor Forge responded to this call. In pioneering forged steel flanges, Taylor Forge had learned a lot about forging technique and piping practice...and both schoolings were prerequisite to the new venture. The projected large diameter pipe was to consist of heavy plate rolled into shape, then hammer lap welded to a smooth, sound weld. This called for heavy, specially designed equipment to make the process work and to provide the first *smooth interior* pipe and pressure vessel cylinders produced in this country.

Typical of the pioneering obstacles was the need for a clean flame to prevent scale forming at the weld, but this problem was solved when Mr. J. Hall Taylor designed and installed a large water gas plant that provided the desired welding conditions.

Thus it was that by 1916 Taylor Forge was making pipe up to 96"; forging all types of end joints on it; engineering it and prefabricating it into hydro-electric penstocks; laterals and Y's for pumping stations, pipe lines, and for similar applications all over the world.

Since the introduction of automatic metallic arc-welding this large pipe has been produced as "Taylor Straight Seam Electric-Weld Pipe," but there are hundreds of miles of the old "Taylor Hammer Lap Welded Pipe" still giving as good service as it did the day it was installed.

An episode in the story of Taylor Forge leadership in designed piping

This old painting—the original in full color—depicted the original process of making Taylor hammer lap welded pipe.

Zone Refining apparatus, showing tube and induction-heating coils. For transistors—tiny electronic amplifiers—germanium is made extremely pure. Then special impurities are added in controlled amounts for best transistor performance.

1 part in 10,000,000,000

To make the most of their revolutionary invention, the transistor, Bell Laboratories scientists needed ultra-pure germanium.

The scientists solved their problem by devising a radically new refining process. The germanium it yields may well be the purest commercially produced material on earth.

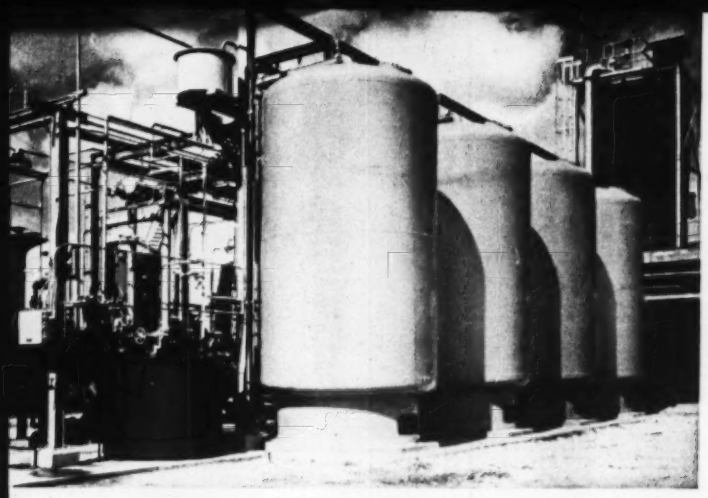
It has only *one part in ten billion* of impurities harmful to transistor performance. That's about the same as a pinch of salt in 35 freight cars of sugar.

Yet the new process, Zone Refining, is simple in principle. An ingot of germanium is drawn through a series of induction-heating coils that melt narrow zones of the substance. Since impurities are more soluble in the liquid than in the solid form of a metal, the molten zones collect impurities. They are swept along by the successive melts to the end of the ingot, which is finally cut off.

Zone Refining is also being applied to the ultra-purification of other materials useful to telephony. This single achievement of research at Bell Telephone Laboratories clears the way for many advances in America's telephone system.

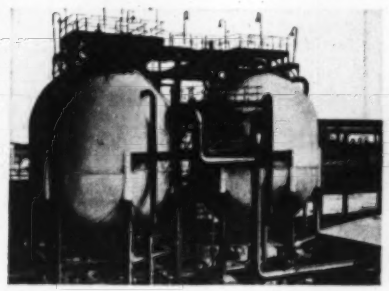
BELL TELEPHONE LABORATORIES

IMPROVING AMERICA'S TELEPHONE SERVICE PROVIDES CAREERS
FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

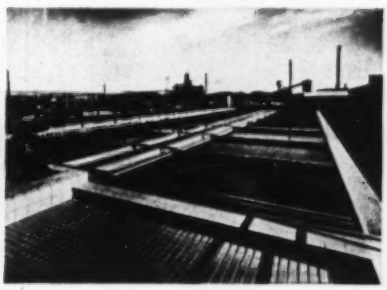


Automatic Demineralization and Silica Removal. *Permutit Ion Exchangers deliver the equivalent of distilled water at far less cost. Eliminate makeup shortages . . . operate independently of changes in turbine load. Fully automatic operation insures precision performance.*

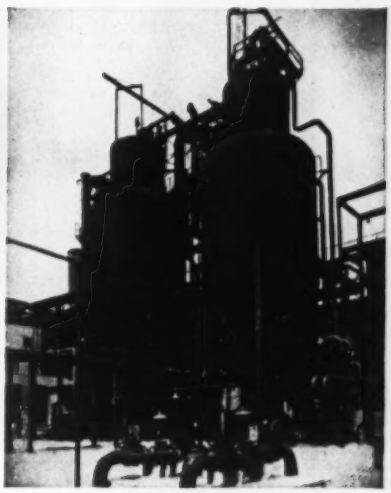
WHICH Permutit Process will solve YOUR water problem?



Sludge-Blanket Hot Lime-Soda Softener *reduces hardness . . . silica . . . alkalinity and turbidity. Fully utilizes Permutit sludge-blanket principle to improve performance.*



Precipitator *clarifies and softens cold water. Uses less space, time and chemicals than previous designs. Removes hardness, turbidity, color, iron, manganese. Reduces silica, alkalinity.*



Deaerating Heater *removes troublesome oxygen and CO_2. Prevents corrosion and pitting of feed lines, stage heaters, economizers and boilers at high temperatures. Steam is used twice . . . deaerates water completely.*

Your Permutit sales engineer can help you decide . . .

Making the wisest choice requires time-consuming consideration of all types of equipment, ion exchange materials, controls, accessories. That's where Permutit can help you.

Permutit Sales Engineers work with a complete range of equipment—all types, all sizes. They do not have to compromise by trying to fit one specific process to your plant.

They can recommend with impartiality the one proper combination of equipment and materials that best solves your problem. For only Permutit manufactures both ion exchange resins and all types of water conditioning equipment.

This results in better performance at lower operating cost . . . undivided responsibility for the complete plant . . . plus savings of time and money in planning and specification.

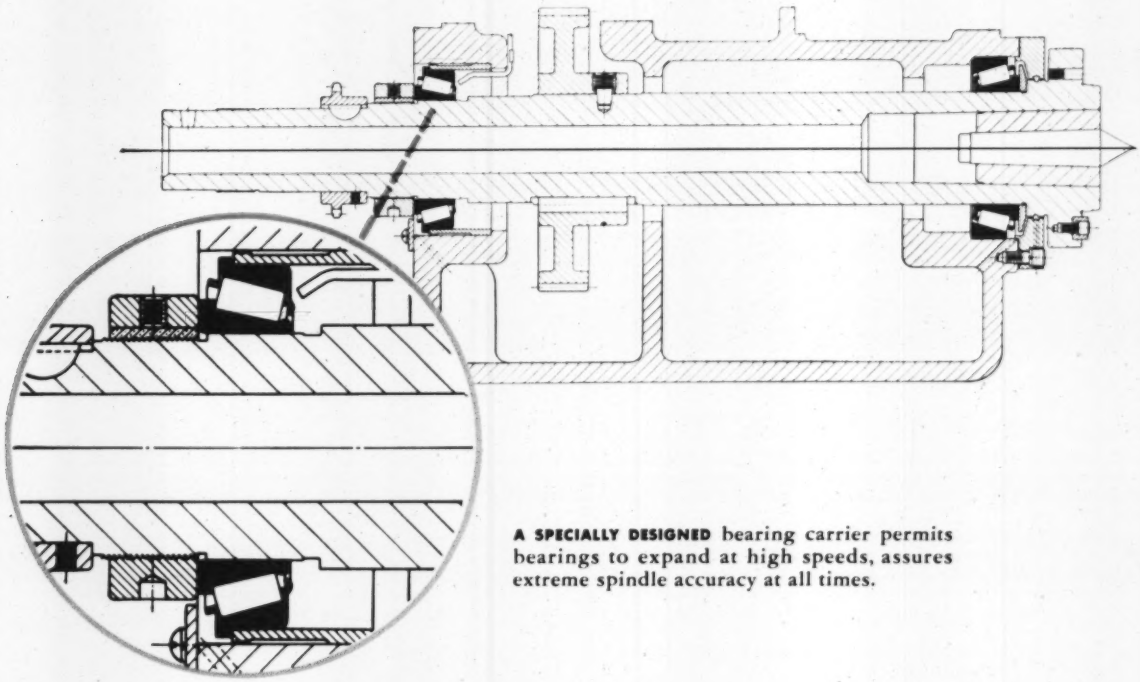
For aid in solving your water problem, write to The Permutit Company, Dept. ME-10, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER FORTY YEARS

PERMUTIT®

How to maintain extreme spindle precision from low to very high speeds:

TIMKEN® bearings with semi-flexible mounting



A SPECIALLY DESIGNED bearing carrier permits bearings to expand at high speeds, assures extreme spindle accuracy at all times.

THE Timken Company has an ingenious solution to the problem of maintaining a high degree of spindle precision in machine tools. At high speeds, bearings expand. Normally this would cause the bearings in a precision mounting to tighten up and become excessively preloaded. But engineers at the Timken Company have developed a semi-flexible mounting. The rear spindle bearing is mounted in a special carrier. The carrier is designed to permit the rear bearing to expand radially while the entire spindle assembly expands longitudinally. As a result the desired bearing setting is maintained under all operating speeds. Extreme spindle accuracy is maintained at all times.

Timken® tapered roller bearings with these mountings have been applied to the spindles of many types of machine tools with great success. Of course not all machine tool spindles are required to operate at high speeds and over a variable range of speeds. The conventional Timken spindle mounting is entirely adequate for most machines.

Whatever your requirements, there are Timken tapered roller bearings to meet them. If not we'll find a new way, as we did when machine tool builders originally asked for precision bearings. And as we did when they asked for greater accuracy, which led to the famed Timken "O" and "OO" bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL AND THRUST ○ LOADS OR ANY COMBINATION